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JOURNAL
OF
ECONOMIC ENTOMOLOGY
OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

VOL. 22 OCTOBER, 1929 No. 5

Proceedings of the Fourth Annual Meeting of the Cotton States Branch, American Association of Economic Entomologists

The fourth annual meeting of the Cotton States Branch was held at Houston, Texas, on February 6 and 7, 1929. The total attendance of 71 exceeded that of any other meeting of the Cotton States entomologists. The program required the time of two long sessions as scheduled, and special attention was given to insect problems of the Southwest. On account of the length of the program, it was necessary to limit discussions. A dinner with appropriate entertainment was enjoyed by the entomologists on the night of Feb. 6. This feature of the program was arranged by the Texas Entomological Society. A trip to see Rice Institute was provided on Feb. 7. At the conclusion of the meeting, some of the entomologists took advantage of an excursion to the Lower Rio Grande Valley to see phases of the Mexican Fruit Worm, Border Inspection and other entomological work.

PART I. BUSINESS PROCEEDINGS

The meeting was called to order by Chairman F. L. Thomas at 2:00 P. M. on Feb. 6 in the Rice Hotel at Houston, Texas. The following members were present:

Amsler, F. P., Gulfport, Miss.
Arnold, Geo. F., A. & M. College, Miss.
Bartlett, O. C., Phoenix, Ariz.
Becker, Geo. G., San Antonio, Tex.
Bibby, F. F., College Station, Tex.
Bilsing, S. W., College Station, Tex.
Bondy, F. F., Tallulah, La.
Chance, O. M., Jackson, Miss.
Clark, S. W., Weslaco, Tex.
Coad, B. R., Tallulah, La.
Cockerham, K. L., Biloxi, Miss.
Colmer, R. P., Moss Point, Miss.
Deen, R. B., Tupelo, Miss.
Dunnam, E. W., Tallulah, La.
Ewing, K. P., Tallulah, La.
Fletcher, R. K., College Station, Tex.
Folsom, J. W., Tallulah, La.
Ford, M. H., Harlingen, Tex.
Gaines, J. C., College Station, Tex.
Gaines, R. C., Tallulah, La.
Gladney, H., Ocean Springs, Miss.
Grimes, D. W., Durant, Miss.
Harned, R. W., A. & M. College, Miss.
Hinds, W. E., Baton Rouge, La.

Hines, Chesley, Yazoo City, Miss.
Hull, F. W., Dickinson, Tex.
Johnston, H. G., College Station, Tex.
Kimball, H. H., A. & M. College, Miss.
Kislanko, J. P., Wiggins, Miss.
Laake, E. W., Dallas, Tex.
Little, V. A., College Station, Tex.
Livingston, B. P., Montgomery, Ala.
Loftin, U. C., Tlahualila, Dgo. Mex.
Lyle, Clay, A. & M. College, Miss.
Moznette, G. F., Albany, Ga.
Newell, Wilmon, Gainesville, Fla.
Owen, W. L., Presidio, Tex.
Reinhard, H. J., College Station, Tex.
Roney, J. N., College Station, Tex.
Singleton, J. M., Hidalgo, Tex.
Snapp, Oliver I., Fort Valley, Ga.
Spencer, Herbert, Baton Rouge, La.
Stewart, M. A., Houston, Tex.
Thomas, F. L., College Station, Tex.
Walter, E. V., San Antonio, Tex.
Yeomans, M. S., Atlanta, Ga.

Report of the Treasurer

Balance on hand, Feb. 2, 1928		$ 7.19
Refund from parent association for expenses for year ending Feb. 1, 1928		23.01
Contributions from members during year ending Feb. 5, 1929		20.00
Paid out		
Printing Nashville banquet programs	$19.75	
Stamped envelopes	17.48	
Printing announcements and programs	6.25	
	$43.48	$50.20
Balance on hand Feb. 6, 1929	6.72	
	$50.20	

Report of the Secretary

The Cotton States Branch membership totaled 205 during the year 1928. There was a net increase of 23 members during the year, after removing the names of those who moved out of the Branch territory. This increase was partially due to the activity on the part of the Branch to secure new members. The number of members by states at the close of the year was as follows: Mississippi 38; Texas 35; Louisiana 34; Florida 24; Tennessee 19; North Carolina 17; Georgia 13; Alabama 9; South Carolina 7; Arkansas 6; Oklahoma 3. The following states showed net increases during the year: Texas 7; North Carolina 6; Louisiana 4; Tennessee 4; Mississippi 3; Alabama 3; Georgia 1. These states showed net decreases: South Carolina 4; Arkansas 1. There were no changes in the number of members in Florida and Oklahoma. There are now 185 entomological workers residing in the territory of the Cotton States Branch who are not members. Many of these are eligible for membership, and members are urged to assist in strengthening the Branch by getting the eligibles to join the Association.

Members of the Branch assisted with the formation of programs, etc., for the Fourth International Congress of Entomology which was held at Cornell University, Ithaca, N. Y., August 12–18.

During the year each member of the Branch was supplied with a financial statement, notice of the annual meeting at Houston, Texas, and a program for the annual meeting.

Chairman Thomas announced the committee appointments as follows: Nominations, S. W. Bilsing, K. L. Cockerham and G. F. Moznette.

Resolutions, W. E. Hinds, G. G. Becker, Wilmon Newell, Clay Lyle and M. A. Stewart. Policy, R. W. Harned, Oliver Snapp and J. W. Folsom. Publications, Herbert Spencer and Oliver Snapp.

Final Business

The final business was transacted late in the afternoon of February 7. Chairman Thomas called for the reports of committees.

Report of the Committee on Policy: This committee recommends (1) That the annual dues of 50 cents be requested from each member to defray necessary expenses approved by the Executive Committee. (2) That each member is urged to assist in increasing the membership of the Association by inviting those who are eligible to membership in the Association to make application for membership. (3) That the Secretary inform the Executive Committee of the Association of Southern Agricultural Workers that more time is needed for our sectional meetings and request that we be permitted to schedule sectional meetings in the mornings if necessary. An amendment was added to this report on the floor as follows: The annual dues shall be $1 instead of 50 cents, and the treasurer shall mail annually to each member of the Branch a notice of the dues and a statement of the financial condition of the Branch. The report was then adopted by motion and vote.

The Publications Committee called attention to the fact that an abstract must accompany all papers presented for publication, and instructed those who read papers at the meeting to send them with abstracts to the Secretary at the earliest date if they had not already been turned in.

The following report of the Resolutions Committee was accepted and adopted by motion and vote:

Report of the Resolutions Committee

Whereas, The Argentine ant, an imported species, is now a pest of great economic importance in many localities in several states, and

Whereas, The Argentine ant is gradually but surely spreading, until it will eventually, if not checked, completely infest the entire area of a large part of the United States, causing an annual property loss of many millions of dollars, and immeasurable annoyance to many millions of people, and

Whereas, It has been definitely and conclusively proven in several places that the Argentine ant can be completely eradicated from any area at little expense by a series of thorough consecutive poisoning campaigns,

Therefore, The members of the Cotton States Branch of the American Association of Economic Entomologists do hereby respectfully urge that the United States Department of Agriculture give this serious fact the attention its importance deserves

including scouting to determine the extent of the distribution, investigations to discover better methods of fighting this pest, and to begin eradication from the United States at the earliest possible date,

Resolved, That a copy of this resolution be transmitted to the Secretary of Agriculture of the United States.

Resolved, That the members of the Cotton States Branch of the American Association of Economic Entomologists deeply regret that Mr. J. A. Berly of South Carolina was called away from this meeting by the death of his mother, and do hereby express their sincere sympathy in his sorrow.

Resolved, That the Cotton States Branch of the American Association of Economic Entomologists express its appreciation of the presence and participation of Dr. Oscar C. Bartlett, State Entomologist of Arizona, and a leader in the Pacific Slope Branch, and trust that he may again find it possible to meet with us.

The Nominations Committee presented the following names for officers during the ensuing year: Chairman, B. R. Coad; Vice Chairman R. W. Harned; Secretary-Treasurer Oliver I. Snapp. By motion and vote the report was accepted and the officers duly elected by a single ballot cast by the Secretary.

The meeting adjourned, to meet next year in regular annual session at the place and time set by the executive committee of the association of southern Agricultural Workers for their next annual meeting.

PART II. ADDRESSES AND PAPERS

The session for addresses and presentation of papers convened immediately following the business session with Chairman Thomas presiding.

COMMENTS ON ENTOMOLOGY IN THE SOUTH DURING THE PAST TWENTY-FIVE YEARS

By WILMON NEWELL, *Gainesville, Florida*

The topic assigned me by your Chairman and Secretary is a very fascinating one, in that there have been many momentous developments, entomologically, during the past twenty-five years and the profession has numbered in its ranks in the South many outstanding, capable, and lovable personalities. During this period entomologists have written much of the history of agriculture in the Southern States. They have done their part in making adjustments, agricultural and economic, which the South has had to undergo in the past quarter of a century in order to survive the onslaught of destructive insect pests.

Due to a combination of circumstances, I have not been able to give to this little review the study and preparation which the subject so

richly deserves. This paper is presented with a frank apology for the omission of reference to many important events and developments, as well as to the particular accomplishments of a host of individuals.

It must be remembered that any complete story of entomology in the South for the past twenty-five years would be a work of volumes and the subject cannot be covered, with credit to all to whom credit is due, in any paper of reasonable length.

As this is the year 1929, the beginning of our twenty-five year period was in 1904. Let us see, briefly, what the entomological situation was in the South at that time.

Unquestionably the boll weevil occupied the center of the stage. Crossing the Mexican border in 1892, the pest had, by 1904, invaded Texas as far north as Denton. It had crossed the Sabine River into Louisiana and advanced as far as Shreveport in the north and almost to Alexandria in the central part of the state. Doctor W. D. Hunter had commenced his study of the weevil in Texas in 1901 and in 1902 had established the Division of Entomology boll weevil laboratory at Victoria and, with Messrs. Hinds, Morrill, Hooker, Yothers, Bishop, A. C. Morgan, W. D. Pierce and others, was busily engaged in studying the insect's life history, enemies and possibilities for damage.

Fred W. Mally, State Entomologist of Texas from about 1898 to 1903, had studied the boll weevil and had issued a very comprehensive bulletin thereon in 1902. He was succeeded as State Entomologist by E. Dwight Sanderson who, in 1905, published results of the first critical statistical study of boll weevil damage.

In July, 1903, the boll weevil had been discovered in the grounds of the Audubon Park Experiment Station at New Orleans and the infestation eradicated. This was followed by the creation of the Louisiana Crop Pest Commission in December, 1903, and in February, 1904, Doctor H. A. Morgan was made its secretary and Entomologist. In August, 1904, Doctor Morgan made perhaps the most startling discovery ever made concerning the boll weevil, and that was that this insect could fly! Prior to that time it had been thought that the insect could perhaps make weak and half-hearted flights from plant to plant and that its chief method of distribution lay in the movement of cotton seed from infested areas. Quarantines to prevent the spread of the boll weevil by this and similar means were in evidence on every hand.

Morgan found that the boll weevil could fly many miles without stopping. This development at once resulted in a new phase of weevil study, the determination of the rate and extent of the annual summer

migration or dispersion. Field workers traced the eastward movement week by week and even day by day. In one instance it was found that the weevil had flown over a 60-mile stretch of swamp and non-cotton country. For many years incurable optimists had predicted that the boll weevil would never cross the Mississippi River. However, the entomologists were now able to predict, not only that it would cross, but also the time and place of crossing. The prediction was fulfilled within three days of the time indicated and at exactly the place (Angola, Louisiana) named.

Just prior to this time H. A. Morgan had determined the life history of the cattle tick, had disclosed the possibility of tick eradication, and had devised a practical method of doing it.

Workers in the Crop Pest Commission of Louisiana succeeded in producing, in 1906, powdered arsenate of lead and its manufacture on a commercial scale was commenced the following year. The same workers demonstrated, in 1909, that the boll weevil could be profitably poisoned —something which had previously been strenuously denied by all other entomologists engaged in the study of the insect. These developments were directly responsible for the subsequent development of calcium arsenate and its wide use for boll weevil control.

Prior to this period Mr. Ed Foster had announced his discovery, in 1891, of the Argentine ant in New Orleans and, with Father Albert Biever, had repeatedly called attention to the menace it presented.

At the beginning of our twenty-five year period, W. M. Scott, then State Entomologist of Georgia, had just shown that lime-sulphur solution, contrary to the reports of previous workers, was effective against San Jose scale in the East and South. Others had based their conclusions on examinations made shortly after applying the spray: Scott watched his sprayed trees for months and found that the lime-sulphur killed slowly, but that it killed and killed and killed.

In Florida the citrus whitefly had been a major problem in the '90's but by 1904 was well on the way to solution by the work of Gossard with insecticides and of H. J. Webber with fungous enemies, particularly the Aschersonia. Their work greatly simplified that of later entomologists, both state and federal, who perfected the control measures for this pest.

The year 1929 not only marks the twenty-fifth anniversary of the founding of Cooperative Extension Work in Agriculture and Home Economics but it is also the twenty-fifth anniversary of the organization of the "Cotton States Entomologists," later to become the Cotton

States Branch of the American Association of Economic Entomologists. Its first meeting was held at Jackson, Mississippi, August 2, 1904, and there were present C. E. Chambliss, A. W. Morrill, H. A. Morgan, Glenn W. Herrick, E. D. Sanderson, W. V. Reed, W. D. Hunter and the writer.

The second meeting of the Cotton States Entomologists, held at Atlanta, May 6, 1905, is here mentioned as an excuse for exhibiting a photograph of that gathering.

The year 1904 also marked the conversion of the "Division" of Entomology, of the United States Department of Agriculture, into the Bureau of Entomology, with resulting increased facilities and personnel for rendering a broader service to the South, as well as to the rest of the country.

During the twenty-five years from 1904 to 1929 there have been many significant developments in the South and during this quarter of a century major insect pests and entomologists have perhaps exerted a greater economic influence than in any area of similar size at any past time. The boll weevil has spread over the entire cotton belt, making necessary a virtual revolution in agriculture. A practical and efficient remedy for the Argentine ant has been developed by Barber. The pink bollworm has invaded the South and is contending for supremacy and the Mexican orange maggot has gained a foothold in Texas. Every southern state has adopted and is enforcing good nursery inspection laws and regulations and, in most instances, plant quarantine regulations as well. Great progress has been made by Howard, Van Dine and others in bringing about definite reduction of malaria over large areas through means of mosquito control. H. A. Morgan's vision of twenty-five years ago that the cattle tick would some day be eradicated from the South is about to be realized: the next five years will, in all likelihood, see the task completed. Marcovitch's work in Tennessee with fluosilicates opened up a virtually new and unexplored insecticide field, Yothers' development of oil sprays for citrus insects has been the means of saving large sums of money, and A. C. Morgan has contributed volumes to the knowledge of tobacco insects and their control.

It is a matter of sincere regret that, as I have mentioned some of the leaders in entomology in the South and their achievements, I cannot mention all. Neither does time permit of reviewing, even were I able to do so, the entomological progress in each and every one of our Southern States during the past twenty-five years.

ENTOMOLOGY IN THE SOUTH TODAY

By R. W. HARNED, *A. & M. College, Miss.*

(Paper not received)

Address of Chairman

WHAT DOES THE FUTURE HOLD IN STORE FOR THE SOUTH?

By F. L. THOMAS, *College Station, Texas*

ABSTRACT

Progress in agriculture is retarded by the occurrence of injurious insects. The contest between man and his insect enemies promises to be especially severe in the South because of the agricultural possibilities of this region and its geographic location. The danger of foreign pest introduction in the South and particularly in Texas is increasing rapidly and will continue to increase with the development of the South. Natural barriers are disappearing with the gradual extension of irrigation projects and general crop plantings in both Texas and Mexico so that it is becoming easier for insects to spread by natural migration aided by winds. We cannot think of allowing another major pest of cotton to spread throughout the belt without adopting strenuous measures. Suggestions to be considered in better safeguarding the South include the strengthening of the inspection service, the encouragement of research agencies to extend their investigations, international cooperation, and biological control methods.

Extension workers from many parts of the nation are gathered here this week to celebrate the 25th anniversary of the beginning of farm demonstration work. The present comprehensive county and home demonstration work began in 1903 with a lone demonstration, the purpose of which was to assist the farmers in producing cotton in boll weevil infested Texas. The wisdom of the nature of that beginning has received abundant verification in the resulting development of agricultural extension. The boll weevil was, then, one of the initial factors which produced the impulse for laying the foundation of extension work. But, lest suggestion be made that a memorial be raised, let us first pause to make sure that it will not serve to remind the people of the history of their own neglect and shortsightedness in allowing the insect to become so thoroughly established.

All of us have heard the expression "blessed San Jose scale" but progress in fruit production was not dependent upon the occurrence of that insect or upon the fight which was made against it. A new grapefruit grove is not set out because the man across the road has been spraying to kill purple scale. The laws of supply and demand in meeting the needs of our rapidly increasing population have been the main factors at the bottom of all agricultural progress, not the fights which have been waged against the insect pests. On the contrary the rate of

progress has been greatly retarded by the occurrence on our farms of injurious insects and plant diseases, thereby causing an expenditure of a vast amount of time, thought, and money, which otherwise could have been devoted to projects of a more constructive nature.

Dr. L. O. Howard, in his memorable address as President of the American Association for Advancement of Science in 1921, drew attention in a very able manner to the importance of insects. In his discussion of the topic "The War Against Insects" Dr. Howard shows that the large numbers of trained workers, teachers, and investigators already employed by institutions, and by state and federal governments mean "we are beginning to realize that insects are our most important rivals in nature and that we are beginning to develop our defense."

If the former Chief of the Bureau of Entomology had taken time to express himself further and in greater detail on the subject, he probably would have mentioned the South as a region where the war will be especially severe and where the defenses should be strengthened at every opportunity. The agricultural possibilities of the South and its geographic location give this region a position of strategic importance for waging a defensive warfare against insects.

Let us take stock for a few moments of the present and relative condition of agriculture in the South. According to the United States Department of Agriculture the total value of 51 important farm crops produced in the country as a whole in 1928 amounted to $8,472,827,000. Practically one-third of this amount or $2,761,663,000 was the valuation of 44 of these crops which were produced in 11 Southern States. More than one-third of the total agricultural wealth is produced in 9 of the Central States not yet reached by the European corn borer. The balance which also approximates a third of the total crop value is produced in the remaining 28 states, including California, Michigan, and Indiana. The reason for directing attention to these groups of states is to show that in the South there is a greater proportion of the agricultural resources of the country which are in more immediate danger as a result of the invasion of foreign insect foes. California, as Dr. Marlatt has said, is one of the bright spots in the country with reference to thorough and efficient port inspection. The people of that state have been aware for a long time of the dangers in allowing insects to enter and as a result their agriculture has been protected. The Central States, including Michigan and Indiana, are in the interior of the United States and thereby protected in large measure from the early appearance of imported insect pests. Although such insects may eventually reach these states, a great deal of valuable information regarding methods of fighting

pests will have been obtained in the meantime. Practical adaptations of this information, even to the extent of testing modified farm machinery, will have been made, so that farmers may have a chance to learn the most approved methods which may be recommended for combating the new pest. And before the insect becomes established throughout the productive area of the Central States, enough information should be available to enable the farmers to successfully cope with the enemy.

Reference has just been made to the interior location of the Central States, where more than one-third of the agricultural wealth is produced. Although several of these are border states there is little to fear from the north, as the following statement of Dr. Howard made in 1897 still holds good: "We have already within our territory practically every species of injurious insect which occurs in British America."

Of the nation's agricultural resources then which may be in more immediate danger as a result of the importation of dangerous pests, a very important, if not the larger proportion, is produced in the South.

How serious to the South is the danger of foreign pest introduction? This question may best be answered by analyzing the information which pertains to the South and which is found in the recent reports of Dr. C. L. Marlatt, now Chief of the Bureau of Entomology and Chairman of the Plant Quarantine and Control Administration.

TABLE 1. SHIPS ARRIVING DIRECT FROM FOREIGN PORTS AND VIA U. S. PORTS, AND THE INTERCEPTIONS RESULTING FROM PORT INSPECTION DURING THE FISCAL YEARS ENDING IN 1927 AND 1928

(Compiled from Annual Reports of Federal Horticultural Board)

	No. of Ports	Arrivals		With Contraband Material		No. of Interceptions of Insects	
		1927	1928	1927	1928	1927	1928
Florida	5	2634	3387	567	787	135	285
Louisiana	1	2272	2152	920	1344	376	315
Texas	2	791	1676	285	383	*25	**17
Alabama	1	165	754	79	251	34	70
So. Carolina	1	225	293	116	129	170	155
Georgia	1		305		94		0
Mississippi	2		48		0		0
		6087	8615	1967	2988	740	842

*110 insects intercepted at 6 ports of entry on international border, 1927.
**182 insects intercepted at 6 ports of entry on international border, 1928.

Inspection records from southern ports for the fiscal year ending June 30, 1928 show that there was an increase of more than 35 per cent in the number of ships arriving direct from foreign ports and via U. S.

ports, over the number arriving at the same ports in 1927. The number of vessels carrying contraband material in 1928 increased approximately 50 per cent over the number in 1927. The total arrivals and interceptions may appear unimportant when compared with records of other ports of the country, nevertheless, the increasing trend of southern shipping is full of significance, especially in view of the future outlook.

The cold, matter of fact opinion of the future outlook as stated by business men is a good criterion of the development and progress in store for the South. The following items occur in a recent number of the "Manufacturer's Record:"

"The goodwill tour of Latin America, which President-Elect Hoover has just completed—has rendered to the South a greater measure of service and material advantages than to any other section. Public interest in our neighbors to the South has been tremendously increased. Business and trade relations will be stimulated.

"The ports of the South are the ports through which the bulk of the trade with our southerly neighbors is shipped and will continue to be shipped—the points of closest contact, the gateways of the U. S. with all Latin America."

In connection with the importation of insect pests from South America through the Atlantic and Gulf ports of the South, it is interesting to note that by far the greater part of South America is in a warmer zone than any part of the United States and even a portion of Argentina is nearer the equator than is any portion of Florida. The possibility of insects arriving from southern countries at any season of the year and becoming established does not greatly tax our imagination.

The danger of pest introduction is also rapidly increasing at other points and in other ways. With an international border touching Texas for nearly a thousand miles innumerable ways occur in which insect pests may gain entrance. Referring again to the Annual Report of the Federal Horticultural Board for 1928 by Dr. Marlatt, it is noted that a total of 12,475 interceptions of 32 contraband plants and plant products were made at the six border ports of Texas where inspectors were located, an average of more than 2,000 interceptions at each port. Two hundred thirty-six of these interceptions contained 326 cotton bolls and 805 pounds of seed and lint. One-sixth of the insects from all countries which were intercepted in the Southern States in 1928 were taken on the Texas border.

The following figures compiled from the Annual Letter of Information No. 40 of the Service and Regulatory Announcements of the Federal

Horticultural Board sum up the interceptions in the Southern States of insect pests from countries to the South including the Bahama and Bermuda Islands during the calendar year 1927.

Southern Countries	No. of Insects Intercepted
Cuba	173
Mexico	128
Honduras	33
Bahamas	27
Guatemala	23
British Honduras, Canal Zone, and Brazil	13 each
Jamaica	11
Chile	8
Porto Rico	7
Panama	6
Dominican Republic	5
Argentina and Costa Rica	4 each
Bermuda and Trinidad	3 each
Martinique	2
Central America	1
	477

Four hundred seventy-seven insects representing at least 150 different species from southern countries would have entered our territory but for the vigilance of the inspectors. Several species of fruit flies, injurious scale insects, weevils, and the pink boll worm were among the insects intercepted. It is also of significance that very little is known about many of the species coming from the southern countries.

The responsibility resting upon the shoulders of those who actually do the inspection work is very great indeed, and for those men and the service they are rendering your chairman has nothing but praise and commendation.

This brief review of the work of the Plant Quarantine and Control Administration in the South shows the great importance of a strong defense if dangerous pests are to be kept out. But what does the future hold in store?

Native insects of potential economic importance become injurious and introduced pests are injurious in proportion to the extent to which agriculture is developed.

Unless we are confronted with some unforeseen catastrophe, the future should be a period of expanding growth for the South. The average man has not visualized the tremendous possibilities in the growth of this section and the wonderful changes that will take place. Agriculturally and industrially the entire territory is making marked progress.

Within a comparatively few years the tourists who have "seen America first" are not going to be satisfied unless they can travel abroad.

Coolidge in two messages has expressed the view that we should lend encouragement for more good roads to all the principal points on this hemisphere south of the Rio Grande. The Pan American Union has endorsed it and an appropriation bill is now before Congress to provide funds for cooperating with Latin countries in formulating plans for an Inter-American highway.

Agriculture, the chief industry of the Mexican people, will progress and be extended with the development of good roads. Irrigation projects south of the Rio Grande will open up new areas which will be devoted to truck, citrus, and cotton.

Rapidly increasing transportation facilities are providing ways which make the accidental importation of insect pests progressively easier, and in spite of all the laws, supervisory boards and inspectors some of these pests are sure to slip in. Then, too, the natural barriers, which have been efficient in the past in preventing the spread of injurious pests, are now fast disappearing with the gradual increase in the number of irrigation projects and the further extension of general crop plantings in both Texas and Mexico. Even under present conditions the pink boll worm moth, by its own power of flight aided by the winds, has reached the cotton fields of Texas. This has just been proved by the well organized and carefully coordinated investigations conducted in Mexico and Texas by the Bureau of Entomology and the Texas Agricultural Experiment Station under the direction of Coad and Fenton. According to their preliminary report the conditions of infestation and windiness in the Laguna of Mexico dominate the progress of pink boll worm infestation in cotton fields of Texas 250 miles away. The natural migration and flights of the pink boll worm are certain to occur from time to time as favorable conditions arise for multiplication of the insect in its Mexican environment. These occurrences will undoubtedly increase with agricultural development and in a few years we may expect that infestation of other pests will result in a similar manner.

The present established insect pests of cotton, for example, already exact a heavy toll throughout the South. The percentage reduction from full yield per acre of cotton due to injurious insects as reported to the U. S. Department of Agriculture by crop correspondents shows the average reduction for three 5-year periods to be as follows:

1911–1915	9.0 per cent
1916–1920	15.7 " "
1921–1925	21.3 " "

The average reduction for the period 1921–1925 chargeable to the boll weevil was 17.3 per cent. The increasing percentages are due mainly to the spread of the boll weevil, and we cannot think of allowing another major pest of cotton to spread throughout the belt without putting up a tremendous fight. A. W. Morrill in a paper presented in 1917 before the Pacific Slope Branch of our Association said, "It is now generally acknowledged, East and West, even in new cotton-growing districts, that the continued success of this great industry is more dependent on the exclusion, control, and eradication of insect pests than on any other factor." One thing seems certain, the South is to be the scene of costly conflicts with insects that sooner or later attend an "advancing civilization."

While the remarks that have been made refer particularly to pests of agricultural crops, they are equally true with respect to insects that cause disease. In this connection the greatest menace, according to Herms, is that of the parasitic tropical and semi-tropical diseases which are insect borne. The rapidity of travel and the thousands of people who come from little known sections of the sub-tropics naturally have the effect of greatly increasing the importance of full knowledge regarding any insects which may transmit disease.

This paper would not be complete if no suggestions were made regarding the proper course to take in planning and erecting a defense that will be worthy of the foes which we may be called upon to fight.

The inspection service should be strengthened; research agencies of state and nation should be encouraged to extend their investigations; more men should be trained, and men should be trained more intensively along fundamental and technical lines so as to be equipped for the necessary work.

Cooperation is needed, especially international cooperation. We must do more to get acquainted with the entomologists who live south of the border. Meetings of this Branch should be held at the border for the purpose of encouraging the presentation of papers by the Mexican members of the American Association. The address by Dr. Howard on the "Entomological Needs of the World" presented before the Entomological Society of America in 1924 contains the following words bearing especially on this subject:

> "The prime insect pests of the world are, through commerce, becoming widespread, and the self protection of nations demands the most intimate knowledge of the injurious insects of all countries, since all of them are potential pests of other regions.

"One of the resolutions adopted by the Pan Pacific Food Conservation Conference recommended the appointment of an international crop protection committee to promote surveys, to encourage research work, to promote the development by each country of large numbers of trained workers, and to obtain agreements and understandings between countries regarding the giving of prompt notification of the appearance of new pests and to secure the cooperation of countries in the prevention of spread."

Already considerable work requiring agreements and understandings between countries has been done and some is now underway, but a great deal more should be done. The increasing number of projects being carried on in this country in a cooperative manner and the increasing number of agencies cooperating in the conduct of the projects promise much for the future.

The need of more intensive investigation of insects now within our borders cannot be over-emphasized. We should have more information about those conditions which may exert an influence on the occurrence and abundance of these pests. As man's influence is extended, additional studies of insect ecology, in both winter and summer, should provide important information even in connection with pests of long occurrence.

The possibilities of the biological method of fighting insects should be investigated before the insects arrive. Central laboratories ought to be established in other countries for investigators to study the natural enemies of injurious insects most likely to be imported, and the practicability of rearing and distributing the parasitic and predaceous forms.

These and many other suggestions must be considered in bringing aid to this and future generations in their efforts to maintain a defense that will properly guard the resources of the South and of the nation in the contests of the future.

ORGANIZATION AND PROGRESS OF PINK BOLLWORM RESEARCH INVESTIGATIONS

By B. R. Coad, *Tallulah, La.*

Abstract

The pink bollworm having become sufficiently abundant in extreme Southwest Texas to permit research investigations, the Bureau of Entomology in cooperation with the Texas State Experiment Station has inaugurated a series of studies dealing with all possible phases of life history and biology in that territory. Headquarters of this work are at El Paso, Texas, with several field laboratories in Southwestern Texas and Northern Mexico. Some of the most interesting results so far have been

in connection with the migratory habits of the species and it has been found that the moths have a distinct migratory period, starting about the first of September and continuing until frost. Airplane collections showed moths present at considerable altitudes in the upper air and it is evident that wind transportation may be an important factor in spread.

The pink bollworm has now been in the United States more than ten years and while large sums have been spent in combating this pest there has not been an opportunity to make a careful study of the life history and habits of the species in the United States. This was due to the fact that the infestations were usually exceedingly light and all efforts were aimed at eradication or repression. Throughout this period the quarantine and other workers attempting to either eradicate or prevent spread, have been greatly handicapped by this lack of knowledge of how the pink bollworm would react to the conditions of our cotton belt if it were allowed to develop naturally. In order to study the life history and habits it was necessary for entomologists to go to countries where the species flourished naturally. Thus Mr. Busck[1] studied the species in Hawaii in 1905. McKinney, Loftin and Hanson,[2] working under the direction of the late W. D. Hunter, made a more detailed investigation in Mexico in 1918 and 1919, and Ohlendorf,[3] under the same direction, also made studies in Mexico in 1921 and 1922. The results of these investigations, together with the work of foreign entomologists, constituted our knowledge of the subject, and while this knowledge was accurate for the countries in which it was gathered, we could not be sure it would apply equally well to our own country. During the past several years, however, there has been a gradual increase in pink bollworm activity in the western areas of the United States and by the fall of 1927 there was an infestation in the Big Bend area along the Rio Grande in Presidio and Brewster counties, Texas, heavy enough to make possible biological investigations.

In this region approximately 7000 acres of cotton for several years in succession had shown very nearly all of the green bolls present in the fall to be infested with pink bollworms. Consequently, the time and opportunity seemed to have arrived for undertaking this much needed research. It was found that the officials of the Experiment Station of the State of Texas had also reached a similar decision and were planning

[1]Busck, August, The pink bollworm, *Pectinophora gossypiella*. In Jour.Agr. Research, vol. 9, No. 10, pp. 343–370, 7 figs., pls. 7–12. 1917.

[2]Loftin, U. C., McKinney, K. B., and Hanson, W. K. Report on Investigations of the Pink Bollworm of Cotton in Mexico. U. S. Dept. of Agr. Bul. No. 918. 1921.

[3]Ohlendorf, W. Studies of the Pink Bollworm in Mexico. Dept. of Agr. Bul. No. 1374. 1926.

to take up the same line of investigation. In order to prevent duplication of effort and produce the maximum efficiency, a plan of cooperation was developed and the work inaugurated on a joint basis; both Federal and State funds are pooled and the entire program is organized as one project, under the joint administration of the Texas Experiment Station and the United States Bureau of Entomology. Direct field supervision of all investigations is in the hands of Dr. F. A. Fenton of the Bureau of Entomology. This system of cooperation has worked out splendidly on the basis that expenditures are made solely in the best interests of the investigation without any reference as to whether the funds happen to come from the State of Texas or the Federal Government. El Paso, Texas, being fairly centrally located has been designated as administrative headquarters and a laboratory and offices established in the country near there. In addition, as Presidio, Texas, is most accessible to the areas of heaviest infestation, a biological laboratory has been established at that point. Other sub-stations have been maintained at Marfa and Castolon, Texas, and in the Laguna District, near Torreon, Mexico.

The general purpose of these investigations has been two-fold: first, to attempt to secure information which will assist in quarantine, repressive or eradication campaigns and second, to start building up a fund of information which may possibly lead to satisfactory control measures in case the species eventually spreads over the main cotton belt of the United States. This general program has been in operation only a little more than a year and there has not been sufficient time to warrant any general conclusions. The sole purpose of the present report is to outline in a general way the work which has been undertaken and to touch on a few high spots of the results which have been secured so far, but emphasizing the fact that *these results are based on only a very brief investigation and cannot be considered as final.*

Projects Under Way

General Life History and Biology. Active work has been started toward working out the complete life history, habits and biology of this insect under the conditions it is encountering in this new territory. This, naturally, is a task which will require years of study but a very comprehensive program is under way covering every possible phase of this subject as far as the prevailing conditions will permit.

Hibernation. Owing to the extreme economic importance of various phases of the hibernation question, considerable emphasis is

being placed on this subject. The studies cover such points as the manner of hibernation, survival under various conditions, emergence time and rate under these various conditions, effects of different repressive measures such as plowing and irrigation on survival, and possible survival on other host plants such as okra, Thurberia, and wild Hibiscus.

FLIGHT. The subject of flight likewise has extreme economic significance in the present situation and has received considerable attention with the idea of ascertaining first, whether or not flight is a factor in spread, and second, the distance and volume of such flight and its relationship to present and possibly future infestations.

GIN TRASH DISPOSAL. Observations during the past few years have emphasized the importance of the gin and oil mill as points for the concentration of infestation, and the extreme importance of prompt disposal of all gin trash. Consequently, a special study on this subject has been inaugurated in cooperation with the Division of Agricultural Engineering of the Bureau of Public Roads with the idea of working out mechanical devices which will most economically assure the complete killing of all pink bollworms in this waste material. Efforts are being made to devise equipment for two purposes. One set will be for the continuous treatment of waste material throughout the period of operation of the gin in the areas known to be infested. The other will be for the purpose of facilitating clean-up of accumulated waste in territory where infestations have been newly found. Numerous variations are being tested but they may all be classified roughly under the three heads of incineration, steam sterilization and milling.

CULTURAL CONTROL. Preliminary results showed such definite indications of possible benefit from improved plowing methods as a winter control that another project in cooperation with the Division of Agricultural Engineering has been undertaken with the idea of trying to apply and adapt some of the knowledge gained in the corn borer fight to plowing methods for pink bollworm control. There is now under way a rather extensive series of experiments involving various types of equipment which are being tested on different soils, at different depths, different dates and both with and without irrigation.

HOST PLANTS. The great importance of host plants other than cotton has necessitated a rather extensive study of pink bollworm activity on those other plants which are known to become infested, and observations throughout the year are under way upon okra, Thurberia and several species of wild Hibiscus.

Some Results to Date

Among the most interesting studies which have been conducted are those relating to the subject of flight. During the past two years there have been increasing indications that, in spite of previous ideas on the subject, flight might be an important factor in spread, and during the season of 1927 nine small isolated trap plantings of cotton were arranged by Mr. L. F. Curl of the Federal Horticultural Board, through the desert and mountain area between the cotton plantings of the Big Bend and those of the Pecos Valley, varying from about 40 to 75 miles from the nearest cotton fields. At the end of the season it was found that 8 out of these 9 plantings were infested with pink bollworms. In addition, there were other indications that we might even be receiving individuals by flight from the large area of infestation in the Laguna District of Mexico, which is only 200 miles due south of our cotton fields in the Big Bend.

Under the circumstances, it was obviously impossible to trace the flight of a single individual or to release marked moths at one point and expect to pick them up at the other, so it was necessary to develop this investigation on a basis of circumstantial evidence, but it was organized in such a way that the results would be as conclusive as possible. This series of flight studies covered the territory from the Laguna to the edge of the Western Extension of the main cotton belt in West Texas; in other words, a distance of between 300 and 400 miles North and South. Throughout this territory a complete seasonal history of infestation was maintained in the various planting districts. In conjunction with this, regular observations were made on moth abundance so that the volume of moths active at any point at any time during the season was known. Nineteen trap plantings were provided in the territory between the Big Bend and the Pecos Valley and between the Pecos Valley and the Western Extension. Migration screens, such as have been utilized in studying the migration habits of the cotton boll weevil, were maintained in the Laguna and in the Big Bend. In addition, airplanes equipped with insect collecting traps were taken to the Laguna and a survey of the upper air insect population was carried on as far as circumstances permitted. In brief, the results of this combined series of observations were as follows: Very few points in the United States showed any infestation whatever prior to the end of August and there was no marked increase throughout this period at those rare points. In the Laguna, infestation increased steadily all the season, becoming complete by about the middle to the end of August. Prior to September 1st, while

the moths were very abundant in the Laguna fields, there was no flight activity whatever, only two moths being collected on the screens during August. On the 3rd of September flight activities started and increased with tremendous rapidity so that within a few days our collections of flying moths on these screens were at least five times as heavy as we have ever encountered with an identical series of screens during the period of maximum migration of the boll weevil. Unlike that of the boll weevil, however, this movement did not reach a peak and then taper off rapidly, but continued in spite of the decreasing moth population until after killing frost. The first airplane collections made over the Laguna were all negative but as soon as the screens started showing active moths the latter also appeared in the upper air and were taken at all altitudes up to 3000 feet above the ground. At approximately 3000 feet it was found that regardless of ground wind conditions throughout the period of our stay, there was a strong contra-tradewind blowing to the North or Northwest. This was so strong that insects apparently did not penetrate into this horizontal current any great distance and while the insect population in the first 3000 feet was heavier than we normally find under similar conditions at Tallulah, in spite of the fact that this is apparently the reverse of actual relative insect population on the ground, these insects became scarce very quickly after the 3000 foot level was passed and hardly any were found above that point. This set of conditions has suggested the theoretical picture of the insects being picked up by the strong convectional currents which are found almost every day in this desert-mountain region. When they have ridden these currents to an altitude of 3000 feet they find a strong horizontal current blowing directly toward the nearest points on the United States border and start off riding this. Unfortunately, we were not able to make flights across the mountain region North of the Laguna. However, it was of interest to note that, whereas it had been almost impossible to find infestation in the Big Bend throughout the season, immediately after September 1st, a rapid rise in infestation started and it seems particularly significant that the first weeks' records were practically all of first instar larvae, such as might be expected from the sudden arrival of a number of migrant moths, instead of being of all stages, as would have been the case due to overlapping generations if this had been brought about by local multiplication from the light infestation found in a few rare fields early in the season.

Another interesting feature is the fact that by comparing the fluctuations in pink bollworm infestation in West Texas from year to year for

the past ten years with various factors, we find little correlation with any factor considered until we study wind movement, when it is found that in every year except one throughout this period there has been a close correlation between pink bollworm activity in West Texas and the amount of windiness in the Laguna and Northern Mexico during the month of September. The one year of exception proved to be a year when a peculiar combination of circumstances brought about a distinct shortage of pink bollworms in the Laguna. It was interesting to note that the wind record for Northern Mexico was comparatively low during September 1928, and to date the findings in the United States indicate considerable diminution in infestation as contrasted with the preceding year. Only two of the 19 trap plantings became infested, and while these were examined throughout the season no infestation appeared in them until in late September or October.

To recapitulate, while there is no concrete proof of flight, there is considerable circumstantial evidence that we do have this wind transportation possibly over comparatively great distances and it may be a dominant factor in our problem.

In addition to these flight records there have been several other rather significant findings during the past season. One of the most important of these is in relation to the possible carry-over of pink bollworms on host plants other than cotton in non-cotton zones established for the purpose of eradication. Pink bollworms have been carried through the winter resting stages and occasionally have pupated and produced normal moths in the spring on host plants other than cotton, though it is apparently not a general condition. Repeated tests have been made with the idea of reestablishing infestation from these host plants either on the same plants or on cotton plants in the spring, but these have been consistently negative. Laboratory experiments along this line were again negative in 1928 but one of the most significant observations was the contrast between open field results at Presidio and Castolon, Texas, during the past season. Castolon is located in Brewster County where there were about 400 acres of heavily infested cotton in 1927 but which was made a non-cotton zone in 1928. Volunteer cotton plants which came up in 1928 became heavily infested before they were destroyed; both okra and Thurberia plants growing in these same fields during the presence of cotton in 1927 became heavily infested but in 1928 with no cotton present there was not a single record of infestation on these plants, whereas at Presidio with cotton present, both okra and hollyhock became infested as usual in 1928. Some biological investi-

gations indicate the possibility that these other plants can not serve as a continuous host for the species but must be reinfested from cotton. It is certainly to be hoped that future investigations will bear this out.

Another interesting feature of the Big Bend investigations was with reference to the emergence from hibernation, a subject upon which we have had almost no information before this time. It was surprising to find that approximately 90 per cent of this emergence was of a suicidal nature as it took place before cotton fruit was available for food.

With reference to the subject of hibernation the most interesting finding was the fact that over 99 per cent mortality of over-wintering stages was produced by winter plowing followed immediately by winter irrigation, whereas these operations at other seasons had comparatively little effect. It is also important to note that spring irrigation greatly stimulates emergence, as this point may be of considerable importance in explaining the failure of some infestations to perpetuate themselves.

The above touches only a few of the high spots of this investigation which seem to be of the most immediate significance, but emphasis should be laid upon the fact that these findings are based on only comparatively brief observations, so can not be considered as conclusive.

In conclusion attention is called to the splendid cooperation of the representatives of the Defensa Agricola of the Mexican Department of Agriculture and the aviation section of the Mexican War Department, whose assistance rendered possible the studies made in Mexico. They spared no effort to facilitate our investigations at every step.

EXPERIMENTS ON THE RELATION BETWEEN THE LOCATION OF COTTON FIELDS AND THE INTENSITY OF BOLL WEEVIL INFESTATION THE SUCCEEDING SEASON

By E. W. DUNNAM, *Associate Entomologist, U. S. Bureau of Entomology*

ABSTRACT

Data collected during 1928 at Tallulah, La., following the floods of 1927 with attendant restriction of cotton culture, tend to show that there is no relation between the distribution of the boll weevil infestation in 1928 and the location of the cotton plantings in 1927.

In the spring of 1927 practically all of the territory in the vicinity of Tallulah, La., was flooded. This was brought about by a break in the Mississippi River levee on May 3. Most of the plantations were totally covered by water, only a very few small areas along the bayou fronts not being flooded. Since the cotton plantations had growing cotton at this

time there was only a small percentage of this crop that was not destroyed. As the flood waters receded there were small portions of certain plantations that were replanted to cotton. The total cotton crop in Madison Parish during this season was about 7 per cent of a normal crop. This condition brought about much speculation as to the effect the flood would have on the boll weevil situation. All of the cotton, however, in both the early and the late plantings was found to be infested. This brought about a very favorable situation for experiments on the migratory habit of the cotton boll weevil. In the spring of 1928 a project was outlined for studying the weevil migration under these unusual conditions, since only scattered fields were available during the preceding year. These experiments were conducted not only in a number of fields where there had been cotton in 1927 but also in cotton one-fourth of a mile, one-half, three-fourths, 1 mile, and 3 miles, respectively, from a single isolated extensive cotton planting of 1927. Some additional tests were made in the woods and in an unplanted field 1 mile from this cotton planting of 1927.

The migratory habit of the boll weevil was studied by means of collections on screen traps. These traps were constructed similarly to those which have previously been used in this work. The screens were then treated on all sides with commercial sticky tree-banding material. These screen traps were set up between May 28 and June 2, inclusive. After installation daily observations were made and all weevils were removed and counted. Weekly examinations were also made to determine the number of weevils in each field where a screen trap was located. Infestation counts were taken and the number of forms, such as squares, blooms, and bolls, were noted. Periodic records of plant height were also made. The weevil counts were made to determine the effect of weevil population on flight. The infestation records were made to determine the effect on flight of relative abundance of weevils, supply of food, and distance from breeding places. The plant-height records were made in order to ascertain if they had any bearing on weevil dispersion.

A total of 25 screens were set up, 11 of which were located in cotton fields which had not been planted in cotton in 1927. Twelve screens were located in cotton fields which had been planted in cotton in 1927, while one was located in the woods and another in an unplanted field. From Figure 36, which shows graphs representing weevils caught on one screen located in a cotton planting of 1927 and on two screens each in fields at various distances from the planting of 1927, it would appear that there was a slight relationship between the cotton planting of 1927 and the number of weevils caught on screens at various distances in 1928. On

the other hand, for comparison, records taken from a number of screens located in cotton fields where there had been plantings in 1927 show greater variations in the daily weevil catch per screen than those shown

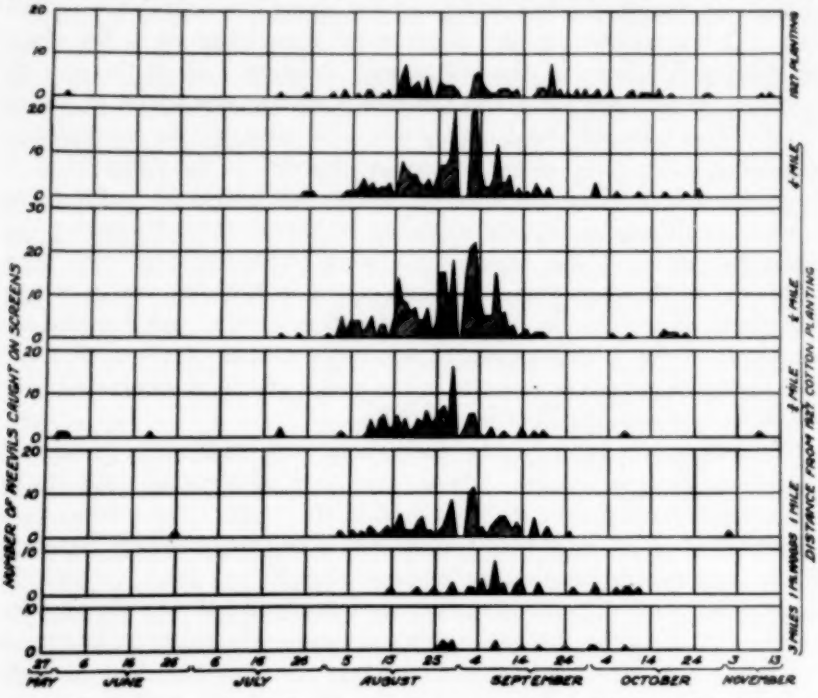


FIG. 36.—Number of weevils caught on one screen located in the field with the planting of 1927 and eleven screen traps located at various distances from 1927 cotton planting; Tallulah, La., 1928.

in Figure 36. There is also very little difference between the total weevil catch per screen under the two conditions. This apparent relationship, therefore, becomes insignificant.

The number of overwintered weevils in the air, early in the spring, before first-brood weevils emerged, seemed to be an important matter. A close analysis of these data shows that there is practically no difference between the number of weevils taken from the screen located in the field where there was a planting in 1927 and the number taken from screens located at the given distances (Figure 36). The numbers caught, however, were comparatively small and after the 2d of July first-generation weevils began to fly, so this classification was discontinued.

The average number of overwintered weevils per acre in small cotton early in the spring also seemed to be important. These counts were

begun May 28 and continued throughout the season, but on account of first-brood weevils emerging, records are tabulated only through July 2 for this classification. There seemed to be no relation between this center of infestation in 1927 and the spring weevil population of 1928 at these various points. These results of early weevil counts are not accentuated in Figure 37 and are therefore given in Table 1.

TABLE 1. WEEVIL ABUNDANCE IN EARLY SPRING IN A FIELD WHICH WAS PLANTED TO COTTON IN 1927, AND IN COTTON FIELDS AT VARIOUS DISTANCES FROM THIS PLANTING

Location of cotton fields in 1928 with reference to cotton planting of 1927	1927 field	¼ mile	½ mile	¾ mile	1 mile	3 miles
Average total weevils per acre counted from May 28 to July 2, inclusive.....	6	6	67	0	43	28

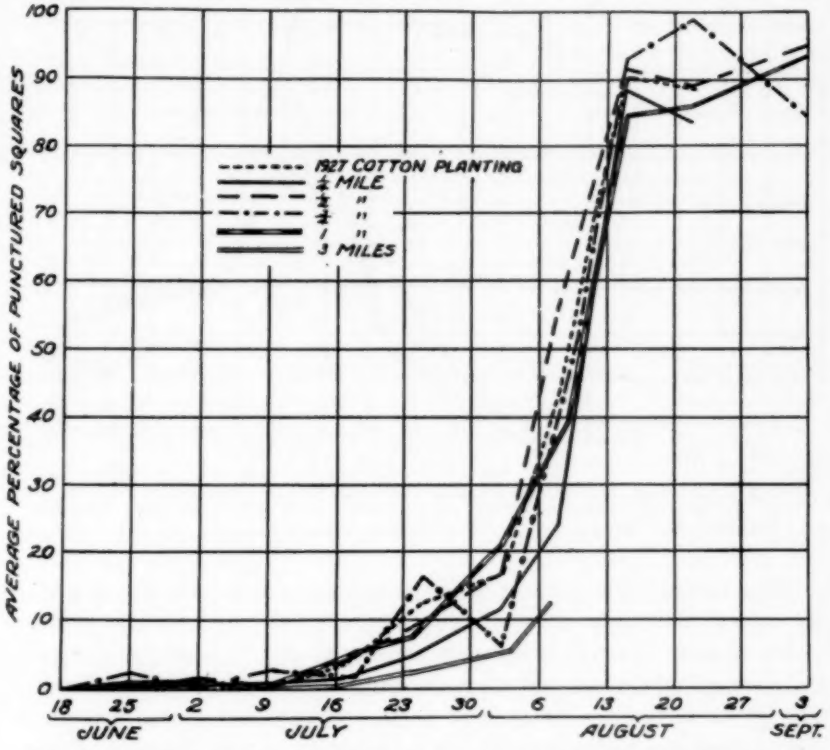


FIG. 37.—Average number of weevils per acre for one field with planting of 1927 and nine fields located at various distances from 1927 cotton planting; Tallulah, La., 1928.

Since the other plantings of 1927 were from 4 to 12 miles distant from this particular experiment, it was thought best to exclude them from

this tabulation. Results, however, for these various plantations show an average total weevil population per acre of from 0 to 134 with an average for all plantations of 39.5 weevils. It is interesting to note that the plantations with the most weevils were about 10 miles nearer to a section of the country which had a normal cotton acreage in 1927 than the experiment field under discussion.

There seems to be no high degree of correlation between average weevil population (Fig. 37) and average percentage of square infestation for these given distances (Fig. 38), or between population and weevils caught. Neither is there a noticeable relationship between percentage of square infestation and number of weevils taken from screen traps.

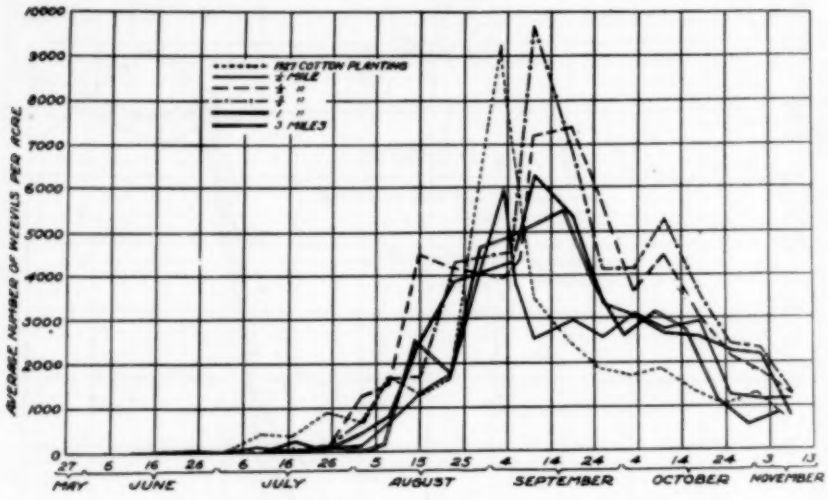


FIG. 38.—Average percentage of punctured squares for one field with planting of 1927 and nine fields located at various distances from 1927 cotton planting; Tallulah, La., 1928.

The average total number of forms seems to have been the determining factor relative to weevil flight. There is a decided numerical correlation between weevils caught on screens at the various distances and the average total forms for corresponding fields as shown by the counts. The greatest average number of weevils caught per screen was at the distance of one-half mile, and the average maximum number of forms was found in these cotton fields. On July 20 the average number of forms was 43.09 per plant. At the distance of one-fourth mile the average maximum was 31.78; at three-fourths it was 31.66; and at one mile it was 26.03 forms.

In the cotton field in which there was a planting in 1927 which served as a source of infestation for these fields at various distances in1928, this relationship is not comparable in Figure 36. It must be remembered that this is the catch of only one screen located in this field while there was one screen located in each of two fields at the various distances. Records were also made for only one field at a distance of 3 miles and no relationship is apparent at this distance (Table 2).

TABLE 2. AVERAGE MAXIMUM PLANT HEIGHTS (IN INCHES) AND FRUITING COUNTS IN COTTON FIELD WITH PLANTING OF 1927 AND IN FIELDS LOCATED RELATIVE TO DISTANCE FROM 1927 COTTON FIELD, ALSO TOTAL NUMBER OF WEEVILS CAUGHT ON SCREENS; TALLULAH, LA., 1928

Distance from 1927 cotton field	1927 Planting	¼ mile	½ mile	¾ mile	1 mile	3 miles
Average maximum plant heights	47.19	49.28	60.84	52.53	45.49	33.66
Average maximum fruiting counts	32.04	31.78	43.09	31.66	26.03	27.01
Total weevils caught on screens	130	204	284	114	98	35

Complete records were made for only six fields in 1928 which had cotton plantings in 1927. This same relationship also existed among these fields (Table 3).

TABLE 3. AVERAGE MAXIMUM PLANT HEIGHTS (IN INCHES) AND FRUITING COUNTS, ALSO TOTAL NUMBER OF WEEVILS CAUGHT ON SCREENS LOCATED IN FIELDS WITH COTTON PLANTINGS OF 1927

Field Number	7	15	17	19	21	22
Average maximum plant heights	47.19	45.32	42.50	47.13	47.10	46.33
Average maximum fruiting counts	32.04	26.50	25.54	20.14	27.12	43.08
Total weevils caught on screens	130	40	60	50	111	189

By studying this table it is apparent that this relationship is marked, especially among the fields with the highest average maximum fruiting counts. By disregarding field number 15, this relationship holds true throughout this table.

Incidentally, in the different fields of cotton, the number of forms as shown by counts in Table 2 appears to have a direct relation to the height of the plant. In Table 3, however, this correlation is not so noticeable. This relationship is to be expected, provided the season is favorable and the infestation of early squares is reasonably low.

Previous observations on the flight of the boll weevil showed no high degree of correlation between time of weevil dispersal and weevil population, or between weevil dispersal and square production, but there was a direct relationship among the three taken together. In other words, the percentage of infestation of cotton forms had a direct bearing on

weevil flight activities. When the flights began the available square supply was decreasing and the weevil population was increasing. This is found to be the case for 1928 when all the records are brought together and analyzed.

It will be noted (Fig. 36) that only intra-field movement was taking place until August 15, when weevils began to fly from field to field and became entangled on screens located in the meadow and woods. At this time the average square infestation was high and there was considerable shifting from field to field.

There is some evidence that part of the weevils infesting these various fields flew in from some other section of the country in the fall of 1927. This evidence is supported by the fact that the average weevil population per acre on May 28 was found to be greater in the field 3 miles distant from a known source of weevils in 1927 than in any other, including all fields under observation which had a cotton planting in 1927. It was also noted that the fields under observation with the heaviest weevil population in the spring of 1928 were those which were about 10 miles nearer areas of normal cotton acreage in 1927 than the distant experiment field, despite the fact that these former fields were also in cotton in 1927. These fields with the heaviest spring infestation in 1928 are about 15 miles distant from the normal cotton acreage zone of 1927, and the experiment field with reference to distance is about 25 miles from this zone of normal cotton acreage.

Previous experiments have shown that examinations of moss in the fall indicate that the number of weevils going into hibernation from a given population is in inverse proportion to the distance of the moss from the field. Experiments with newly-emerged overwintered weevils tend to show that the weevils do a minimum amount of flying early in the spring. Since there was no volunteer cotton in this territory in 1927, it therefore seems entirely possible that the spring infestation of 1928 was brought about not only by weevils that were bred in these fields of cotton but partly also by weevils coming in from elsewhere.

One year's records are not sufficient to warrant any definite conclusions, yet this year's results at Tallulah, La., tend to show that there is no relation between the distribution of the spring infestation in 1928 and the location of the scattered cotton plantings in 1927. In other sections of the country the situation may be entirely different. The distance from a supplementary source of weevils may possibly be an important factor in early spring infestation.

THE UNEVEN DISTRIBUTION OF *HELIOTHIS OBSOLETA* (FABRICIUS) ON COTTON IN TEXAS

By ROBERT K. FLETCHER, *Entomologist Texas Agricultural Experiment Station*

ABSTRACT

Some of the possible causes for the uneven distribution of *Heliothis obsoleta* on cotton are briefly considered. These are rainfall, soil, the possible attraction of the moths to cotton plants because of an increased secretion of nectar in certain localities, or their possible attraction to cotton covered with honey-dew.

The cotton boll worm, *Heliothis obsoleta*, occurs throughout Texas. The injury of this insect to corn, especially in the Atlantic and Gulf States, is notorious. In Texas toward the height of the season we have often found one hundred per cent of the ears to show injury. This amount of injury, too, was found to extend throughout extensive areas. That is, injury from *Heliothis obsoleta* to corn presents a certain evenness of distribution. In cotton, on the other hand, while boll worm injury often causes serious loss and extends over many thousands of acres, it presents an unevenness of distribution which is very conspicuous. This characteristic of boll worm injury in cotton is such a constant phenomenon that we have been led to give it careful consideration in the hope that in the causes thereof we may find a key to the control of this pest. It is the purpose of this paper to consider briefly some of the possible causes for this "spotted" distribution.

Quaintance and Brues in Bureau of Entomology Bulletin Number 50 discuss the relation of weather to boll worm injury. In their discussion they bring out the following points with reference to rainfall:

1. The belief "firmly established in the minds of many cotton planters that rainy weather, especially during late July and early August is largely responsible for severe boll worm injury to cotton." "The fact that it is just at this time that the hardening of the field corn forces the moths to the cotton field is lost sight of." "However, this belief appears to have some foundation in fact."

2. "The occurrence of a soaking rain and the consequent softening of the soil would permit the escape in perfect condition of many moths which under conditions of hard-baked soil must have perished in their pupal condition." The authors state that in the course of their investigation "that moths were noticeably more abundant after a soaking rain."

3. "Abundance of suitable food appears to be a vital necessity for the normal longevity of the moths. Furthermore, laboratory records show that oviposition does not really begin until after the female has been able to partake of food. The food of moths during the months of July

and August, under outdoor conditions, consists partly of such nectar as may be obtained from flowers, but principally of nectar from the nectaries of cotton flowers and squares, and it would appear reasonable that during periods of drought this nectar supply would be far less copious than during rainy weather."

4. "During the larval or boll worm stage it is most exposed to the attack of parasitic and predaceous insect and other enemies, which, on the whole, are much more active during dry than rainy weather." "In the egg stage the boll worm is subject to parasitism by a minute chalcidid fly (*Trichogramma minutum* Riley), the importance of which in destroying boll worm eggs doubtless varies much with the character of the weather. It is almost certain that these insects are not active during rainy weather, as they could scarcely live under such conditions. It is further probable that they are actually destroyed in large numbers by the rain despite their effort to secure safe retreat."

These possibilities of the effect of rainfall upon boll worm infestation in cotton, as stated by Quaintance and Brues, seem reasonable. When we consider that rainfall may be very unevenly distributed over even limited areas, thus affecting in varying degrees the boll worm environment, it seems probable that it may, at least in a measure, account for the "spotted" distribution of the insect.

It has been suggested that the type of soil may have some influence upon the emergence of the adults. The fact that severe boll worm injury is frequently seen in cotton grown on bottom lands and in cotton grown on black lands seems to bear out this idea. However, the infestation in corn has not been found to vary with the soil type. For instance, the infestation in corn on the soils of the Brazos Bottom has not been found to vary greatly from that in corn grown on the adjacent upland. Again boll worm injury to cotton has been found to vary extensively upon the same type of soil in the same locality.

The fact that boll worm moths feed upon nectar from the nectaries of the cotton plant and that cotton secretes more nectar in some environments than in others leads naturally to the supposition that nectar secretion may have some influence upon the distribution of cotton boll worm injury to cotton. That is, the moths would be attracted more to those cotton plants producing the most nectar and would therefore deposit more eggs on such plants. In reply to a letter to Mr. H. B. Parks, Chief of the Division of Apiculture, of the State Apicultural Research Laboratory, San Antonio, Texas, upon the distribution of nectar production in cotton he replied, in part, as follows: "During the past ten years I have put in considerable time in studying the nectar

secretions of cotton and have reached the following conclusions: cotton is nectar-bearing on all black soils whenever there is an abundance of heat and moisture present; cotton is nectar-bearing on all alluvial soils during a majority of years, conditions for honey-flow unknown; cotton is nectar-bearing on grey or red soil only under the most favorable conditions; cotton is nectar-bearing on sandy lands occasionally and in very limited areas." Nectar-bearing as spoken of here refers only to the conditions where the nectar is available to the honey-bee. Mr. Parks, however, clearly shows that there is a great variation in cotton as a nectar producing plant in various localities and under different climatic conditions.

If cotton boll worm moths are attracted to cotton by nectar may they not also be attracted by other sweetened substances? We have some data which tends to show that they may be. Mr. J. N. Roney of Texas Experiment Station carried on an experiment at McKinney, Texas, in trapping boll worm moths using a 50–50 solution of molasses and water as a bait. He placed his traps with the entrance downward just above the cotton plants, spraying that portion of the plant covered by the trap with the solution. The following records show the number of boll worm moths caught in a single trap in the period specified. Plants from which the solution was washed or had been eaten did not attract moths.

BOLL WORM MOTHS CAUGHT IN A SINGLE TRAP

Period	No. Moths Caught	Average Per Night	Greatest No. One Night	Remarks
Aug. 17–Aug. 25 incl.	41	4.5	10	Plants resprayed twice.
Aug. 26–Sep. 5 incl.	82	7.4	19	Plants resprayed twice.
Aug. 27–Sep. 14 incl.	34	1.8	5	Plants resprayed three times.
Sep. 6–Sep. 16 incl.	32	2.9	12	Rain on night of 14th, not resprayed after the 14th.
Sep. 16–Sep. 22 incl.	36	5.1	12	Plants resprayed once.
Sep. 18–Sep. 29 incl.	71	5.9	21	Plants resprayed once. Rain in early morning of 27th. Not resprayed after.
Sep. 23–Sep. 28 incl.	9	1.5	4	Plants resprayed once after rain. Rained 27th. Plants not resprayed.

These data strongly indicate that boll worm moths are attracted by sweetened bait.

There is a substance other than nectar commonly found on cotton plants, i. e., honey-dew. After dusting with calcium arsenate for the control of the cotton boll weevil it is a common occurrence for cotton to become heavily infested with aphids, following which the leaves become covered with honey-dew.

In 1927 Mr. Franklin Sherman III, at that time a member of the staff of the Texas Experiment Station, made a series of interesting observations showing that cotton boll worm infestation on cotton became more severe following the dusting of the cotton with calcium arsenate. Mr. Sherman reported in part as follows: "In all places observed the infestation and damage continued to increase in spite of dusting. Not only was this true where the cotton was dusted by airplane with 5–6 pounds of dust per acre but on demonstration plats, where every care was taken to insure thorough dusting, where as much as 12 pounds of dust per acre were applied, no noticeable results were obtained. On one such plat dust was applied at five day intervals from June 29 to July 30. The boll weevil was checked and bolls formed to the very top of the plants. The boll worms, however, continued to increase and by August 10, had destroyed a large share of the bolls saved from the boll weevil by dusting." Mr. Sherman's observations are borne out by those of other members of the staff and by those of Mr. George Chance, manager of the plantation on which the observations were made.

Dr. J. W. Folsom has shown in the JOURNAL OF ECONOMIC ENTOMOLOGY, Vol. 20, No. 6, page 840, December 1927, that the increase of aphids on cotton following dusting with calcium arsenate is first because of the "positive phototropic reaction of the winged females to white substances" and second because of the "killing of hymenopterous parasites when they emerge in the presence of the arsenical." These two facts may also account for the increase of boll worms on cotton after dusting. In view of the data showing the attraction of boll worm moths to molasses and water solution, however, it seems plausible to assume that they may likewise be attracted to honey-dew.

EFFECTS ON THE COTTON PLANT OF THE FEEDING OF CERTAIN HEMIPTERA OF THE FAMILY MIRIDAE[1]

By K. P. EWING, *Assistant Entomologist,*
Division of Cotton Insects, U. S. Bureau of Entomology

ABSTRACT

Experiments with six hemipterous insects belonging to the family Miridae (***Psallus seriatus***, ***Lygus pratensis***, ***Adelphocoris rapidus***, ***Creontiades debilis***, ***Poeciloscytus basalis***, and ***Lygus apicalis***) proved that each species when allowed to feed on cotton plants caused the young squares to shed or become blasted, produced lesions along the main stem, branch stems, and leaf petioles, and caused mutilations of leaves.

Hemipterous insects have received comparatively little attention from cotton entomologists until within the last few years. Since 1923 the cotton flea hopper (*Psallus seriatus*) has occasioned much interest and frequently alarm owing to its damage to cotton. No doubt this species has troubled the cotton farmer more than any of the other hemipterous insects. It is a known fact now that other Hemiptera of the same family cause injury to cotton similar to that produced by *Psallus seriatus*.

Experiments have been conducted with six different species of insects belonging to the family Miridae, and the feeding of each species on cotton caused what might be termed "hopper damage," a type of injury similar to that caused by the cotton flea hopper (*Psallus seriatus*).

These insects, in the order of their importance, are: *Psallus seriatus* Reut., *Lygus pratensis* L., *Adelphocoris rapidus* Say, *Creontiades debilis* V. D., *Poeciloscytus basalis* Reut., and *Lygus apicalis* Fieb. The first four have been found infesting and causing damage in fields of cotton. The last two, as far as is known, are not cotton pests. The experiment with them was merely to determine whether or not other mirids besides those commonly found on cotton were capable of producing typical "hopper damage."

The literature on *Psallus seriatus* has been published within recent years. Investigators have determined positively that this insect causes small squares or floral buds to die or be aborted, and the plant to grow abnormally. Swellings, or what are commonly called "lesions," are also caused from the feeding of this insect upon the cotton plant.

Adelphocoris rapidus, formerly termed *Calocoris rapidus*, has been known to cotton entomologists since the time of Glover (1)[2] in 1855. Later (1893) Mally (2) wrote of this insect doing damage to cotton

[1]The punctures, or abrasions, on cotton plants described and figured herein were in every case the result of feeding and not oviposition.

[2]Reference is made by number to Literature Cited, p. 765.

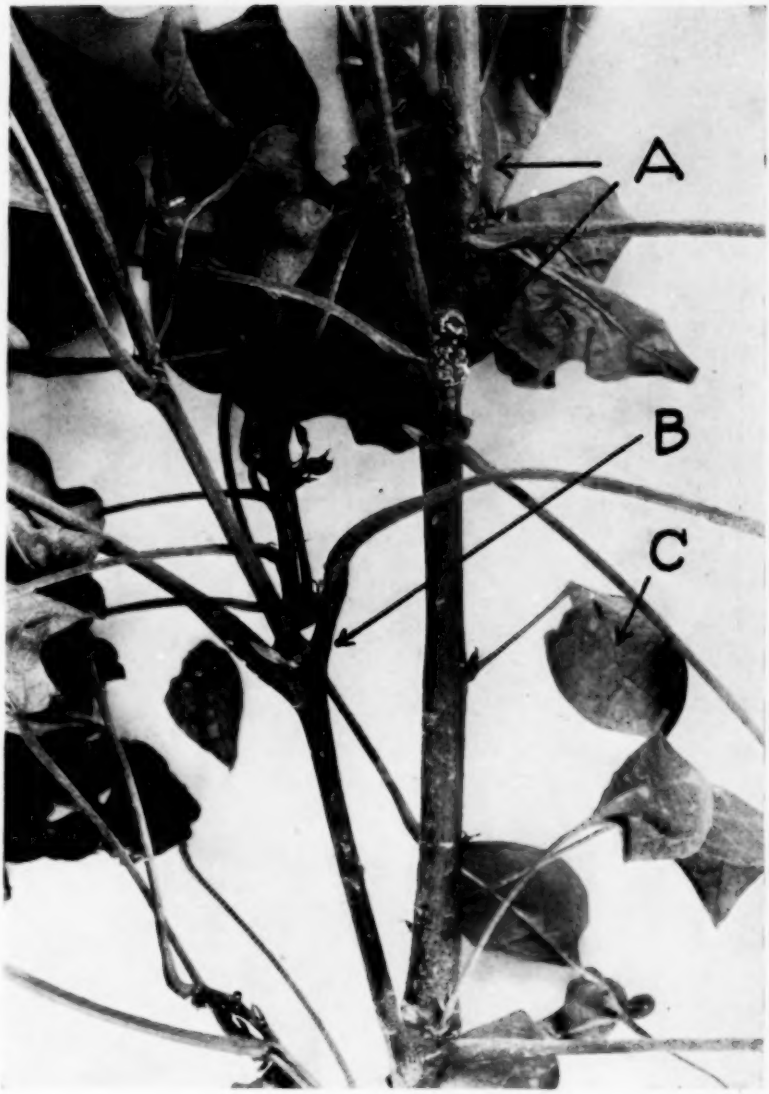
bolls. A more extended account was given by Sanderson (3) based upon observations in Texas in 1906. He reported *Adelphocoris* damaging squares as well as bolls. Quite recently (1927) McGregor has given an account of the damage by *Lygus elisus* to cotton squares, blooms, and small bolls in California and Arizona. Of the older entomologists J. D. Mitchell (4) was the only one who (in 1898) definitely attributed the destruction of small squares or floral buds to a species of Miridae, and his conclusion was reached on circumstantial evidence. Neither he nor any of his contemporaries reported any lesions on the cotton plant caused by mirids.

The experiments with these insects proved that they cause the young squares to shed or become blasted; that they produce lesions along the main stem, branch stems, and leaf petioles, and cause mutilations of leaves. Some of this proof was secured by permitting individual insects to feed on portions of the cotton plant, especially the main and branch stems and leaf petioles. Other experiments were conducted to secure "hopper" damage by exposing, to the insect, the entire cotton plant growing under a cage in the field. The cages used were 4 feet square by 4 feet high covered with 16-mesh galvanized wire screen or unbleached muslin. The screen cages were found to be the best; however, the muslin cages were used for *Psallus* as the 16-mesh screen was too coarse to retain this small insect.

During the summer of 1928 cage experiments to determine the injury to cotton plants were conducted at Tallulah, La., with *Adelphocoris rapidus*, *Lygus pratensis*, *Psallus seriatus*, *Poeciloscytus basalis*, and *Lygus apicalis*. The cage experiments with *Creontiades debilis* were conducted at Port Lavaca, Texas, during 1925.

One of the difficulties in carrying on cage experiments with this type of insect is the high mortality experienced. None of the insects introduced into the cages reproduced enough to keep up a normal infestation on the cotton plants, so for this reason, and the fact that the mortality of the insects introduced was so great, best results were obtained by introducing a number of insects into each cage at weekly intervals.

From one to eight cages were used for each of the six species of Miridae used in these experiments. Six check cages were also utilized. Each cage contained 3 cotton plants. The insects were introduced into the respective cages at intervals for approximately nine weeks, and weekly examinations of the cotton plants were made in most of the cages for about the same length of time. It was found from these examinations that each species of mirid caused small squares to be blasted, reduced the number of live forms that would normally have been present on the



Gross damage to cotton plant caused by *Psallus seriatus*. A, Lesions on main stem; B, Abnormal branching; C, Malformation of leaf. (Nearly natural size.)

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plant, caused numerous lesions to appear on the main stems, branches, and leaf petioles, and caused mutilations of the leaves.

To be more specific, a comparison of the results secured in the cages containing three of the species and the check will be mentioned. The figures given below show the average number of insects per plant and not per cage. At the beginning of the experiment, or when the insects were first introduced into their respective cages, the average numbers of live squares present on plants in the different cages were as follows: Check, 9; *Adelphocoris*, 7; *Lygus pratensis*, 9.2; and *Poeciloscytus*, 6. At the termination of the experiment, or nine weeks later, the live squares present were as follows: Check, 45; *Adelphocoris*, 6.3; *Lygus pratensis*, 17.5; and *Poeciloscytus*, 22. The total numbers of "hopper squares" removed from the cages during the experiment were as follows: Check, 0; *Adelphocoris*, 62.1; *Lygus pratensis*, 68.7; and *Poeciloscytus*, 50. The plant heights, in inches, at the beginning of the experiment were as follows: Check, 11.1; *Adelphocoris*, 12.8; *Lygus pratensis*, 16.2; and *Poeciloscytus*, 16. The plant heights at the termination of the experiment were as follows: Check, 53.2; *Adelphocoris*, 46.7; *Lygus pratensis*, 36.3; and *Poeciloscytus*, 37. Figures 1 to 6 inclusive show damage to certain parts of cotton plants by the various species of mirids.

In the beginning considerable difficulty was experienced in handling the mirids and securing damage from individuals of the mirid family. The method used to best advantage in getting individual insects to feed on the cotton plant was to place the individual in a small glass vial and secure the vial to the plant with adhesive tape. The size of the vial depended upon the size of insect used, the smallest being about 4 millimeters in diameter and 20 millimeters in length. The open end of the vial was ground out so that the curved end just fitted the circular cotton stem. These small, light-weight vials were fitted to the stem in such a manner that mechanical injury to the stem seldom occurred.

Exposure of the plant to insect feeding was of two types. In one the insect was left in the vial on the plant for 24 hours; in another the insect was placed on the stem or petiole until it was observed to puncture and feed on the plant. The first type, where the insects were applied to the

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EXPLANATION OF PLATE 23

2.—Cotton leaf injured by *Psallus seriatus*. Note marginal deformity, perforations and translucent areas. (Two-thirds natural size.)

3.—Portions of main stem of cotton plant showing lesions caused by *Adelphocoris rapidus*. (Enlarged 1½ diameters.)

4.—Portions of main stem of cotton plant showing very severe lesions caused by *Lygus pratensis*. (About natural size.)

plant and fed for 24 hours or longer, was termed "24-hour exposure," and the second type, where the feeding of the insect was observed, was termed "observed feeding." In the latter case the length of the feeding period was noted. It was found that starving the insect from 4 to 12 hours before exposure induced feeding. Ink marks were made on the cotton stems just outside the vials to facilitate later identification of the place of puncture. Observation of the feeding process, in most instances, required a hand lens, though a binocular microscope was preferable. In some cases, however, feeding can be observed with the naked eye.

It is interesting to note that observed feeding did not always result in apparent external injury. However, in most instances where external evidence of injury was not apparent from such feeding, it was found by microscopical examination of the sectioned material in the vicinity of the puncture that internal injury had occurred.

The external injury was noticeable in the form of swellings or lesions. These lesions appear from 1 to 4 days after the puncture is made.

The size of lesions varies; some are about half the size of a pin head, or barely distinguishable, while others are 2 or more millimeters in diameter. Sometimes these lesions split, exposing a tan-colored granular material beneath, which becomes darker with age.

During the summer of 1928 a total of 48 cases of observed feeding were secured with *Psallus seriatus*, 111 with *Lygus pratensis*, and 12 with *Adelphocoris rapidus*. Of the 48 *Psallus seriatus* cases, 8 were under 5 minutes in length, 15 were between 6 and 15 minutes, 17 were between 16 and 30 minutes, and 8 were between 31 and 60 minutes. Twenty-three of these tests showed positive results, 20 were negative, and 5 were doubtful. Of the 111 tests of observed feeding of *Lygus pratensis*, 31 were under 5 minutes in length, 43 between 6 and 15 minutes, 8 between 16 and 30 minutes, and 1 between 30 and 60 minutes. Sixty-six of these tests showed positive results, 40 were negative, and 5 were doubtful. Of the 12 cases of observed feeding of *Adelphocoris rapidus*, 5 were under 5 minutes, 3 between 6 and 15 minutes, 3 between 16 and 30 minutes, and 1 over 60 minutes. Four of these tests were positive, 3 were negative, and 5 were doubtful.

The length of time the insect fed seemed to have very little if any effect upon the extent of the injury.

EXPLANATION OF PLATE 24

5.—Portions of main stem of cotton plant showing lesions caused by *Lygus apicalis*. (Enlarged two diameters.)

6.—Leaf petioles of cotton plant showing lesions caused by *Poeciloscytus basalis*. (Enlarged about 1½ diameters.)

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Thirty-one 24-hour exposures were secured with *Psallus seriatus*, of which 24 showed positive results, 3 negative, and 4 doubtful. Sixteen 24-hour exposures were secured with *Lygus pratensis* of which 11 were positive and 5 negative. Thirty-seven 24-hour exposures were secured with *Adelphocoris rapidus* of which 22 were positive, 11 negative, and 4 doubtful. Forty-two 24-hour exposures were secured with *Poecilloscytus basalis* of which 41 were positive and 1 doubtful. Sixty-one 24-hour exposures were secured in the case of *Lygus apicalis*, of which 23 were positive, 20 negative, and 18 doubtful.

In the observations and study of mirid punctures no evidence tending to show that the damage caused by the insect extended very far from the point of puncture was found. Both internal and external examinations of the lesions which resulted from the punctures showed only local injury in the vicinity of the puncture. This injury seldom extended more than 2 millimeters from the point of puncture and never more than 5 millimeters.

LITERATURE CITED

1. GLOVER, T. Insects frequenting the Cotton Plant. Rept. U. S. Comm. Patents for 1855; 1856.
2. MALLEY, F. W. Report on the Bollworm of Cotton. Bull. 29 (old series), U. S. Dept. Agr., Div. Ent. 1893.
3. SANDERSON, E. D. Report on Miscellaneous Cotton Insects in Texas. Bull. 57, U. S. Dept. Agr., Bur. Ent., 1906.
4. HOWARD, L. O. Some Miscellaneous Results of the Work of the Division of Entomology. U. S. Dept. Agr., Div. Ent. Bull. (new series) 18, p. 101, 1898.

THE VALUE OF SPRING EMERGENCE RECORDS ON THE COTTON FLEA HOPPER, *PSALLUS SERIATUS*

By H. J. REINHARD, *Entomologist Texas Agricultural Experiment Station*

ABSTRACT

The occurrence of destructive cotton flea hopper, *Psallus seriatus*, infestations on cotton apparently are determined by the status of the current crop at the time when the peak of spring emergence of the insect occurs. In the two seasons, 1927 and 1928, when the maximum number of insects emerged during March, at which time very little young cotton was available in the field, little or no injury to the crop by this species was produced. During the spring, 1926, the peak of emergence occurred about April 15, after cotton was up generally to a stand in the field and extensive injury by this species to the crop resulted in many sections of the State.

Practically every year there is a general demand in this State for information concerning the extent of infestation that may be expected especially with reference to the more important cotton insect pests. Although our entomological research agencies are primarily concerned in establishing new facts regarding the behavior of economically important insects, the interpretation and application of the facts assembled

in anticipating likely outbreaks or severe infestations of any major pest is an important phase of the research program. This is a desirable procedure particularly with such insects as the boll weevil and cotton flea hopper. In fact, studies of the factors conducive to early season abundance of these insects on cotton are becoming more and more important as evidenced by the increasing demand for information on prospective outbreaks. The purpose of this paper is to discuss briefly the value of annual emergence records on the cotton flea hopper in determining the prospects for the occurrence of destructive infestations on cotton.

About 10 years ago when the cotton flea hopper assumed the status of an important pest on cotton in Texas very little, if any, authentic information was available concerning the species. No one was able to anticipate what might be expected in the way of infestations on cotton or in which localities these were likely to occur. When the point was definitely established that this insect hibernates in the egg stage plans were made to develop some means of taking emergence records for the purpose of determining its early season abundance in the field. The method devised for taking the emergence records has been described in Texas Station bulletin 377, and need not be discussed here, except to state, that infested host plants of the insect are gathered from any desirable location during the winter months and are caged about February 1, for observation on subsequent hatching of nymphs.

Comparable data on the spring emergence of the cotton flea hopper are now available for the period, 1926–1928, inclusive. This period includes one season (1926) when injury by the insect was general and severe, followed by two seasons of generally light infestations on cotton which produced little or no injury to the crop. Although data have not been taken over a sufficient time to warrant any definite conclusions, they are serviceable, at least, in defining the conditions under which destructive infestations of this insect on cotton are most likely to occur. A brief summary of the data available for each season is given in the following paragraphs.

During the season, 1926, the *Croton capitatus* host plants under observation averaged 89 cotton flea hopper nymphs per plant. Less than 4 per cent of the total emergence occurred in March. About 91 per cent of all the insects emerged during April at a time when cotton plants were up generally in the field. Unprecedented injury to the crop resulted.

The preferred host plants of the cotton flea hopper contained enormous numbers of eggs during the winter of 1926–27. *Croton capitatus*

plants placed in cages in the spring of 1927 average 219 nymphs per plant. Approximately 79 per cent of the total emergence had been effected prior to April 1, at which time cotton was not generally planted. Little or no injury was produced by the insect during this season.

In 1928, the caged *Croton capitatus* plants averaged only 44 cotton flea hopper nymphs per plant. Over 45 per cent of the total emergence was completed by April 1, with the peak occurring during the week beginning March 26, when cotton was not yet generally up to a stand in the field. No severe injury by this insect to the crop resulted although some localized infestations on cotton occurred late in the season.

These data become significant when considered in conjunction with the factors affecting emergence of the cotton flea hopper. Temperature and precipitation appear to exert the most important influence in this connection. Climatological records for the past three seasons indicate that average mean monthly temperatures from 60 to 63 degrees F., with 2 to 5 inches of well-distributed rainfall, approach the optimum combination of conditions for the procedure of maximum emergence of this insect from the overwintering eggs. Normally these optimum requirements are approximated during March in the important cotton producing regions of this State with the possible exception of northwest Texas.

In the season, 1927, when 79 per cent of the total cotton flea hopper emergence had occurred by the end of March with a normal mean temperature and rainfall very little injury to cotton resulted notwithstanding the fact that the insects emerged in enormous numbers.

Similarly little injury was done by the insect in the season, 1928, when again the peak of emergence occurred during March with a practically normal mean temperature and precipitation.

Since flea hopper injury to cotton in Texas was general and severe in 1926, the factors affecting emergence of the insect during that season may be considered favorable for the recurrence of destructive infestations. It has already been stated that large numbers of nymphs hatched during the spring of that season. However, none hatched in February and less than 4 per cent of the total emergence was effected during March. The mean temperatures for this month recorded at 116 stations located in all sections of the State were below the normal. Rainfall on the other hand was above the average at every station where data were taken. In April the precipitation was nearly normal for the month and the mean temperature was 62 degrees F., only slightly above the normal for March. Under these prevailing conditions about 91 per cent of the total cotton flea hopper emergence occurred and subsequent widespread injury to cotton resulted in this State.

These observations illustrate an important point for consideration in defining conditions for the likely occurrence of destructive flea hopper infestations on cotton. Namely, that knowledge of the time at which maximum emergence of the insect occurs with respect to the status of the current crop is fully as essential as data on the total number of insects which may hatch from the overwintering eggs. In other words, a heavy spring emergence of the cotton flea hopper is not always necessarily followed by severe injury to the crop.

The conditions favorable and unfavorable for the occurrence of destructive cotton flea hopper infestations, as indicated by the data cited, may be summarized and contrasted briefly as follows:

When low temperatures and excessive rainfall during March, 1926, held emergence of the flea hopper in abeyance until cotton came up generally to a stand in the field before the peak of a heavy emergence was attained, unprecedented injury to the crop resulted during the season.

The peak of a very heavy cotton flea hopper emergence in the spring, 1927, and of a lighter emergence of the insect in the spring, 1928, occurred during March with the mean temperature and precipitation for the month in both years approximating the normal. Very little young cotton was available in the field at this time and little or no subsequent injury to the crop by insect resulted anywhere in the State.

PRELIMINARY STUDIES REGARDING PHYSICAL QUALITIES AND DISTRIBUTION OF SODIUM SILICOFLUORIDE DUSTS

By W. E. Hinds, *Entomologist, Louisiana Experiment Station*

Abstract

Field experimental work with sodium silicofluoride dust applications applied to corn and sugarcane for control of the sugarcane borer has been conducted at the Louisiana Experiment Station during the seasons of 1925, 1926 and 1927. These tests have shown that there exists in different brands and mixtures of these dusts such great variations in dusting qualities as to indicate that physical texture, free flowing qualities, lightness, etc. may be as important as its chemical character in determining the value of a dust for insecticidal purposes.

This article deals with a preliminary study of some of these physical qualities and their effect upon the distribution of the dust through the dust swath. The method of comparing these dusts is described and the results obtained in a series of 24 tests with 8 different materials are shown. The study includes comparisons of the quantity of dust deposited per 1,000 square inches of area at points located at 15, 30, 45, 60 and 90 feet from the outlet of the dusting machine. The character of particles deposited is shown visually through micro-photographs with a magnification of 64 diameters and photoprints made for the dust sample at each distance. The full study includes

chemical analyses which indicate considerable separation of the sodium silicofluoride particles from hydrated lime particles when such a mixture is blown out and spread by air current to a considerable distance. These studies can be correlated also with field records on borer control and foliage burning with cane.

The use of sodium silicofluoride dust applications for the control of the sugarcane borer was started at the Louisiana Experiment Station in September 1925 and found to give an encouraging degree of mortality among the borer larvae under conditions where the application of calcium arsenate dust had had practically no effect upon the borers. Since that time the work with sodium silicofluoride has been greatly increased especially during the seasons of 1926 and 1927 and all members of the Staff of the Department of Entomology have collaborated in the field work. During 1928 no dusting tests were conducted because of the comparative scarcity of borers in either corn or cane.

In the course of these field tests which included applications of dusts by various types of machinery varying from the simple hand dust gun to the insecticide dusting airplane, it became evident that there existed wide variations in the physical qualities exhibited by these different dust materials used. The tests included a number of different brands of sodium silicofluoride and a large number of modifications of these original materials made by including hydrated lime, sulphur, flour, dextrine, silica, talc, magnesium sulphate, sodium silicate, diatomaceous earth, etc., in varying percentages with a view to securing, if possible, a more even distribution of the silicofluoride and more effective control of the borers together with a reduction in the burning effect on the foliage of corn or cane.

Naturally the results from these numerous field tests showed that the distribution of the dust material was, in many cases, very uneven and that the results in the burning of foliage and in the control of the borers varied accordingly. It appeared probable that a very large wastage of poison occurred in some portions of the dust swath, and with it an unnecessary degree of injury to the foliage, whereas in other portions of the dust swath there might not be sufficient poison to secure a reasonable degree of control of the larvae. The conclusion was reached that the physical quality, and possibly other factors affecting the distribution of the dust, may be just as important in the final results as is its chemical composition. Furthermore where mixtures were made of materials of different chemical composition and density, it appeared probable that a separation of these materials might occur in the dust cloud with a resultant variation in chemical composition of the material deposited in different parts of the dust swath.

From these field observations we were led to believe that a very decided improvement was possible in sodium silicofluoride dust materials and that the improvements which seem most desirable at the outset would include fineness of texture and free separation of the particles of the basic material, homogeneity in chemical composition and physical characteristics so that there would be no change in chemical composition at different points across the dust swath, an increased lightness of material which would favor the distribution of a wider dust swath, and the reduction in the tendency to burn the foliage.

The basic material used in these tests is sodium silicofluoride, or fluosilicate as it is often called, which may contain from 97 to more than 99% pure sodium silicofluoride. Such material should contain approximately 60% of water soluble fluoride. This pure material has usually given in field applications the highest percentage of kill among the larvae of borers and also the burning effect on cane foliage is likely to be more severe than with more dilute materials. It is supposed that the burning of foliage is due to the presence of a small amount of free hydrofluoric acid or possibly hydrofluosilicic acid which may be formed as the material is brought into solution in rains or dews. The reduction of burning was sought through the inclusion of either chemically inert diluents which simply reduced the strength of the mixture proportionally or the use of chemically active ingredients which might combine with the free acids which we believe may be responsible for the burning.

In any such dust materials the size and weight of particles, and other physical characteristics, are tested severely when the material is thrown out as a dust cloud and spread by air currents with the expectation of covering effectively a swath width which would make the application an economic proposition. In boll weevil control work the dust swath of calcium arsenate distributed by an insecticide dusting airplane may cover effectively a width of more than 200 feet. In comparison with this the effective swath width with sodium silicofluoride materials has been considered as approximately only 100 feet in width. If the desired improvement can be made in the physical texture of Sodium silicofluoride dust materials, it should be possible to cover as wide a dust swath with this as is done with calcium arsenate, and this would reduce greatly the cost of application either with airplanes or with the larger types of dusting machines which might be used in the early part of the season before the sugarcane becomes large enough to prevent the passage of such machinery through the field.

To obtain light on some of these points a series of Laboratory tests was started by the writer in July 1927 with the assistance of Mr. B. A.

Osterberger and Mr. W. T. Hunt of this Department. The chemical analyses involved have been made by the Louisiana State Chemical Laboratory under the direction of Chief Chemist A. P. Kerr. The experimental work was undertaken in the Livestock Judging Pavillion of the Louisiana State University. This Building furnished a convenient location on account of its size and the open space across which the dust cloud could be projected, while the Building itself gave a practically still atmosphere so far as outside air currents were concerned. A brief description of the general set-up and method of operation should be given.

The dust cloud was secured by using a Root hand dust gun with the feed set wide open and with crank revolutions standardized at 30 revolutions in 30 seconds of time. The dust gun was set up in a fixed position at an elevation of about 15 feet above the ground. A constant air current was supplied by an Emerson 12-inch electric fan run at low speed and set about 1-foot under the discharge from the dust gun so that the dust cloud would be carried along by the air current across the Pavillion. The center of the fan was about 12-feet higher than the level of tables on the ground below where the dust samples were collected. The velocity of the air current in front of the fan and on the level with it and measured at the point giving highest velocity was determined by a very delicate anemometer as being approximately 200 feet per minute at a distance of 15 feet and approximately 110 feet per minute at a distance of 30 feet. At 45 feet the current had fallen to 30 feet per minute and at 60 and 90 feet it was not measurable.

The dust cloud generated in 30 seconds of turning of the fan was in most cases considered heavy. A time interval of 5 minutes was allowed for the settling of the dust before the samples were collected. The samples were taken by exposing large panes of glass, 28 x 30 inches, lying horizontally on tables at a distance of 15 feet, 30 feet, 45 feet, 60 feet and 90 feet across the dust swath. At each distance there was exposed also a microscope slide coated with albumen fixative. This slide held the dust deposit as it settled and has kept these samples well preserved for microscopic examinations subsequently. The dust deposit on each of the five large glass plates was scraped together by a rubber-edged window scraper and placed in a small vial so that each sample was separate and could later be weighed and examined chemically. Thus for each observation point we secured material that could be studied quantitatively, physically and chemically.

The samples for microscopic examinations can be compared best by making photo-micrographic records and comparing the prints from

each sample in a set and for the various sets of five samples as desired. These records have been made by using a 16 m.m. objective with a Leitz Micca Camera. This equipment gives a magnification of about 64 diameters upon the photographic plate. In this work we used regular lantern slides for the photographic negatives and have made a series of prints from these negatives. Lower magnifications might be used so as to include a larger section of the original deposits. This plan gives quite easily a permanent, visible record of the distribution, size, etc., of dust particles at various points across the dust swath. This phase of the work is illustrated by representative sets of such prints which are shown herewith.

In addition to this microscopic examination chemical analyses are made upon each sample collected. These analyses have shown that in some dust mixtures there is a distinct separation of sodium silicofluoride particles from particles of other materials used in the mixture and the proportion varies at different points of dust deposits.

It is evident already that some dust mixtures may be eliminated from consideration entirely upon the basis of such a study as we have indicated above. It becomes apparent that for some reasons the physical characteristics of some mixtures are not favorable for successful distribution of the dusts upon wide areas in the field. Such dusts might be used for certain purposes where the area of distribution is limited but could not be distributed effectively where the dust swath is wide. Combinations which are favorable to desired physical qualities can be seen and the direction of further investigation is favored by such observable results. Such records may, of course, be correlated with the results of actual field experimental work and they serve to explain in some cases the reasons for severe damage or for decreased efficiency of material. Chemical manufacturers are usually very glad indeed to cooperate with the Economic Entomologist in preparing materials according to his specifications for such special experimental work and particularly is this true where the materials involved contain so great promise for widespread future usefulness as does sodium silicofluoride.

In the tests referred to in this paper, it is not assumed by any means that the conditions represented are comparable with those obtained in the field where our airplane dusting work has been conducted. It is very certain, for example, that the difference which we find in the weight of dust deposited at 15-feet as compared with 45-feet from the outlet is with our equipment far greater than it would be in a 45-foot distance in the field where the dust was applied from an airplane. An indication of the variations in the weight of dust deposit per 1,000 square inches of area is shown for our tests in the following table:

WEIGHT OF DUST DEPOSITS OF SODIUM SILICOFLUORIDE MATERIALS IN LABORATORY TESTS

Dust Tested	Weight, gms. per 1,000 sq. inches, at 15 ft.	30 ft.	45 ft.	60 ft.	90 ft.	Total gms. 5000 sq. in.
AACC—2A Straight.....	17.04	2.06	.70	.12	.02	19.94
AACC—2B "	21.65	3.68	1.70	.12	.03	27.18
AACC—2C "	16.34	2.64	1.00	.46	.03	20.47
AACC—3A & 10% Lime..	25.95	4.17	1.00	.63	.05	31.80
AACC—3B " " " ..	25.23	4.58	1.00	.044	.013	31.38
AACC—3C " " " ..	30.00	3.60	.86	54	.05	35.05
JXL—F & 10% Lime....	1.55	.38	.50	.29	.10	2.82
JXL—G " " "	3.40	.86	.46	Trace	.06	4.78
JXL—H " " "	3.77	1.40	.28	.01	.01	5.47
JXL—I " " "	.70	1.42	.29	.4	.2	2.47
JXL—K " " "	.01	1.56	.54	.19	.01	2.31
JXL—L " " "	5.67	1.18	.38	.09	.06	7.38
AC#8—4D Straight.....	1.00	2.46	.36	.07	.10	3.99
AC#8—4E "	.36	3.55	.61	.40	.25	5.17
W#10—6A "	26.20	2.11	.43	.14	Trace	28.88
W#10—6B "	11.85	.93	.70	.31	.05	13.84
W#10—6C "	2.80	1.15	.54	.09	.01	4.59
W#10—6D "	15.52	.67	.60	.34	.04	17.17
W#11—5A "	6.05	2.14	.80	.30	.01	9.30
W#11—5B "	6.56	1.31	.58	.22	.02	8.69
W#11—5C "	2.68	.86	.54	.33	.06	4.47
JXL "	.04	.23	.01	.02	Trace	.30
JXL & 10% Lime.....	3.12	.88	.05	.01	Trace	1.06
Cal. Arsenate.....	1.14	.53	.17	.06	.01	4.91
Totals, all tests.....	228.63	44.34	14.10	5.184	1.183	293.42
Average, all tests.....	9.53	1.85	.59	.22	.05	12.23

Even a casual examination of the table above shows some very wide variations in the amount of dust falling on a given area at the same distance from the dust outlet with the various dusts used. In the average of all tests about 78% of the total dust deposit recovered fell at about 15 feet from the dust outlet and with a drop of about 12 feet in that distance under our test conditions.

SOIL ANIMALS INJURIOUS TO SUGARCANE ROOTS

By HERBERT SPENCER and C. L. STRACENER, *Baton Rouge, La.*

(Withdrawn for publication elsewhere.)

A CONSIDERATION OF THE "COLD WATER TREATMENT" IN THE CONTROL OF THE SUGAR-CANE MEALYBUG

By T. E. HOLLOWAY, *New Orleans, La.*

(Withdrawn for publication elsewhere.)

THE PLANT LOUSE PROBLEM OF THE TEXAS GULF COAST

By FRANK M. HULL, *Texas Agricultural Experiment Station, Dickinson, Texas*

ABSTRACT

Standard control measures of other sections fall down because of low temperatures and high winds. Various dosages of calcium cyanide were tried out from the standpoint of shortening of time period of exposure with regard to the possibility of fumigating beneath cheap tar paper covers. Heating of nicotine sprays and of nicotine dusts seem to offer promising results in sections with cool temperatures in the growing season. Increased efficiency or greater dilution and cheaper treatments are considered as possibilities of the use of heat.

Along the Texas Gulf coast there are several important vegetable producing centers. One of these is located in Galveston, Harris and Brazoria counties. Here the most profitable time of growing truck is during the winter months when cool temperatures and relatively high and constant winds prevail. For several years past plant lice have given an unusually large amount of trouble to growers of vegetables and have even threatened the extinction of the industry in the section. Out of the two factors above mentioned have arisen most of the difficulties encountered in applying those so called standard control measures which meet with success elsewhere. The Texas State Experiment Station began a study of the problem in the fall of 1927 at its substation, located at Angleton. It is the object of the Texas Experiment Station to find suitable measures to take in the control of these insects, involving both new remedies and modification of old ones. The insect chiefly involved is the turnip louse or false cabbage aphis (*Aphis pseudobrassicae*). The injurious effect of this species is exaggerated or increased by the operation of a second and equally prevalent form, the Turnip Root Louse, *Pemphigus populi-transversus*, whose summer host plant is the cottonwood.

It must be said that a part of the troubles of the vegetable grower of the section are due to his extreme haphazard method of cultivation. Growers, many of an alien blend, accustomed to bedding up soil in wide hastily made beds, sometimes fifteen feet broad and upon which seed are broadcast, have brought much of the trouble needlessly upon themselves. During the last year the study of the problem was directed along lines with the hope of finding methods not involving changes of customary sectional growth practices. Experiments were conducted with standard preparations of Nicotine Sulphate, Pyrethrum extracts and various commercial sprays and dusts. As a result of these experiments we find that, as far as dusts and sprays are concerned, the wastages involved in treating broadcasted crops due to the abundance of

unhealthy, spindling plants is prohibitive. Coupled with this is the fact, that such unhealthy non-maturing plants, harbor lice abundantly and that in a broad bed of truck with thousands of plants crowded into a few square yards or block-fashion, the most careful job of spraying or dusting, leaves numerous plants untouched, to breed lice and re-infest the bed. It may be noted that the average acre requirement of such truck was found to be six hundred or more gallons of spray or sixty to one hundred pounds of dust.

The next attempt at control has been in the direction of fumigation. Out of a number of possible gasses, such as arsine, hydrogen cyanide, phosphine, methane, sulphur dioxide, chlorine, etc., hydrogen cyanide and nicotine were selected. Efforts were first directed towards ascertaining whether the minimum dosage applicable to the foliage in question could be made compatible with the necessary equipment, from a standpoint of cost. It was felt that the possibilities of clean kill, etc., compensated in no mild degree for added cost of equipment, and possibly greater expenditure of time. The dosage selected as a basis of experiment as being practicable from a materials cost standpoint was .0285 ounces of calcium cyanide per seventy cubic feet per hour. In preliminary tests this dosage was found to leave the foliage unharmed. The next steps were directed towards suitable materials for applying same. What seems to be promising material is that type of paper manufactured for enclosure of brass pipe fittings, and consequently of very heavy material coated on one side with tar and cheesecloth. The material is quite cheap.

Experiment of this nature was continued until the beginning of the past year and the transfer of the work to a farm leased by the Texas State Experiment Station, located in Galveston county and known as the Plant Lice Laboratory. There for the present, are being grown crops under drilled conditions and experiment is being directed along the line of modification of spraying and dusting methods.

One such modification is the use of a small gasoline heater attachment to serve to condition the air of the dust gun to where nicotine gas will be liberated even at the lowest temperatures. This apparatus is designed to be inserted in the middle section of the delivery tube. It represents an adoption of the resevoir and burner of a Coleman heating iron to the purpose mentioned. An extra piece of copper piping has been welded into this apparatus in order to further remove the gasoline tank from the heated pipe. The greatest difficulty was experienced in obtaining suitable adjustment of the protecting sleeves on the outside. These form a double envelope and are so arranged that the wind cannot ex-

Dusting Experiments

Material—Black Leaf Fifty; lime 75 parts; dolomite 25 parts; Strength 1%

No.	Kind of Dust	Size of Truck	Acre Rate	Acre Time	A. cost without Labor	Preliminary Infestation	Subsequent Infestation	Percent Kill	Temperature
	Black-leaf 50; no cover	6–8	144	5 hr.	$4.26	100	36	64	
1	no heat			20 min.		100	15	85	45
	Black-leaf 50; covered	6–8	120	11 hr.	$3.55	99	27	72.7	
2	no heat			20 min.		98	12	87.7	45
	Black-leaf 50; covered	6–8	180		$5.32	99	10		
3	and heated					99	1		45
	Black-leaf 50; covered	6–8	220	10 hr.	$6.51	100	45	55	
4	no heat					100	4	96	78
	Black-leaf 50; no cover	6–8	120	6 hr.	$3.55	100	56	44	
5	no heat			36 min.		100	14	86	78

Spraying Experiments

No.	Kind	Size of Truck	Acre Rate	Acre Cost Without Labor	Preliminary Infestation	Subsequent Infestation	Percent Killed	Strength of Material	Temperature
	Black leaf 50	3–4			95	60	36.8	1	
1	Hot	in.	212	$3.14	94	30	68.0	800	72
	Black leaf 50	3–4			94	60	36.1	1	
2	Cold	in.	185	$2.73	90	34	62.2	800	77
	Evergreen	3–4					75.4	1	
3		in.	176	$5.28	57	14		400	
	Black leaf 50	4–6			99	78	21.2	1	
4	Hot	in.	290	$4.29	96	17	82.3	800	46
	Black leaf 50	4–6			100	80	20.0	1	
5	Cold	in.	180	$2.66	92	36	60.0	800	46
	Destruxol	4–6			100	96	4.0	1	
6		in.	220		100	68	32.0	800	47
	Black leaf 50	6–8			100	82	18.0	1	
7	Cold	in.	276	$4.08	100	43	57.0	800	58
	Black leaf 50	6–8			96	53	44.0	1	
8	Hot	in.	193	$2.75	90	9	90.0	800	58

tinguish them in the field, no matter how hard it is blowing. We have had no difficulty in superheating the mixture of air and dust to a temperature of one hundred and fifty degrees. There seems to be no ill effects to foliage from this temperature. A second departure from old methods lies in our attempt to improve the value of spray-mixes, especially those containing nicotine. We find that it is no difficulty at all to raise the temperature of solutions to one hundred and fifty to one hundred and eighty and even to two hundred degrees. Even when delivered from copper spray tank the drop in final tank temperature is seldom over forty degrees. Of course some kind of go-between is necessary between the back of one's shirt and the spray tank. Three things are possible, we think with heated sprays. One, is cheaper spray through greater dilution, or higher resulting lethal effects at the same dilution, another is less total spray used, thereby cutting down the time required for application. The following tables show some of the results of spraying and dusting.

THE TEACHING OF ENTOMOLOGY

By M. A. STEWART, *The Rice Institute, Houston, Texas*

ABSTRACT

An account is presented of a course in introductory entomology given with the viewpoints of providing thorough training in the true fundamentals of entomology, creating an intelligent public interest in the work and needs of present day entomology, and attracting desirable students to enter the profession of entomology.

From time to time a paper is read before an entomological meeting criticizing the present methods of teaching entomology and urging an improvement in teaching methods and from time to time a paper is presented describing the need of well trained men; men who are trained in the fundamentals of their science as well as in the more superficial and limited phases. It is a well known fact that the demands upon entomological workers grow heavier each year and the necessity of a more thorough training becomes increasingly important. It is a common complaint that our entomological students are leaving colleges but poorly equipped for the work that is expected of them, particularly those who enter the economic field, and teachers are consequently accused of not even keeping up with the progress of entomology, to say nothing of anticipating the needs of the future.

There seems to be today, and has been for a number of years, two main schools of thought in the teaching of entomology. One of these is the teaching of entomology in such a way that by far the greater amount

of emphasis of every course is placed on pure taxonomy and the other is the teaching of the pure economic aspects of entomology without a sufficient background of the other phases of the subject. Frequently the entire department of entomology in any given university is dominated by one or the other of these viewpoints. The result of this is that the student leaves the university for academic, museum or economic work with a distorted vision of the comparative values of the various phases of entomology. This distortion is the cause of the very frequent condemnation of the taxonomist by the economic worker and vice versa. It can be emphatically stated that an alarmingly great number of students complete even their graduate work with a lack of sufficient knowledge of the true fundamentals and essentials, the biology of insects, upon which their profession is based. They are trained in a limited field and have little tolerance or understanding of other phases of this very diverse field of scientific endeavor.

With this point of view in mind the writer established a new course in entomology this past fall and the results have been so favorable that he proposes to describe the work in detail in this paper. The course was primarily organized as a more or less cultural course, with the hope of establishing in the minds of future citizens a general knowledge of what the science of entomology is, giving them an opportunity for increased enjoyment in life through a knowledge of the more interesting and fascinating insects encountered in every day life, and more important still to educate a certain portion of the public to the problems faced by entomologists and the necessity of public understanding, interest, and support in order to effect the best results.

At the same time, however, the feeling was strong that, in view of our present weaknesses, here was an opportunity to attempt to establish a course in entomology dealing with the fundamentals in such a detailed and thorough fashion that a sound foundation would be laid for further work on the part of the student, adequately equipping him for graduate work of a high standard and subsequent research or administrative work in either systematic or economic entomology.

This course, based upon the idea of equipping a student for efficient work in entomology is presented by means of a weekly schedule of three lectures and one three hour laboratory period. The subject matter is described below.

The reasons for studying entomology are presented together with the history of the science and a brief survey of the entire class Insecta, including the relative sizes of the orders. This is followed by a not too technical, but thorough, consideration of insect anatomy, both

internal and external, which is presented in close conjunction with the known facts of insect physiology, thereby lessening the curse of dry unadulterated morphology. This method of teaching insect morphology has proved very successful as shown by the unusually interested attitude on the part of the students. Immediately following the consideration of the anatomy and physiology of insects, metamorphosis is studied with great care, which leads to the taking up of the chemistry and physiology of hibernation. After this color and coloration are described in detail, taking up the origins and development of colors and color patterns, including the chemical and physical factors involved, the various laws which these appear to follow, the influences of various environmental factors, and the advantages and disadvantages of color and color pattern. Obviously this leads to protective resemblance and mimicry, which is considered in a careful fashion, attempting to show clearly the utility of color and the over-emphasis which is frequently placed upon this function. The strength of each theory advanced is analyzed. After this rather prolonged study of color and coloration, insect behavior is studied very thoroughly. The types of behavior, the stimuli bringing forth such reactions, the variations in behavior, the factors causing these variations, and the analysis of various phases of the behavior of different insects are all treated with equal care. This is followed by a rather detailed account of the application of this knowledge as carried out in the present trend to combat injurious insects by methods based upon their behavior. Also a description of various research problems, which might further this practical application, is given.

The part of the course described above might be considered as the first part. The second part is a study of insects in general, grouped, not according to a taxonomic or phylogenetic relationship, but according to general ecological situations and their adaptations to each general situation, such as the adaptations of aquatic insects; insects in relation to plants; insects in relation to flowers; considering the reciprocal modifications of both insects and flowers; insects in relation to other animals from the standpoint of food relationships; interrelations of insects; economic aspects of the relation of insects to man; including a study of the purposes of quarantines, how quarantines are determined, established, and administered, and a brief consideration of some quarantines now in effect; the causation and transmission of disease of man and domestic animals; and the distribution of insects. This phase of the course is concluded by a consideration of rearing insects, collecting insects, and the preparation and care of insect collections.

What might be considered as the third part of the course is devoted to the study of the order of insects, beginning with the most primitive and gradually working up to the most complex. The diagnostic characters of each order and what is known of the relationships between the various orders is studied. In each order one or more typical examples, depending upon the size and complexity of the order, are studied in detail, as regards structure, habits, life-history, and economic importance; the more striking variations from the typical are also considered. During this progressive study of the various orders careful attention is paid to the evolution of social habits. As each order is taken up its comparative importance to man is described. Also during the third phase of the course, training in identifying insects with the aid of keys is introduced; determinations being made in most cases only to families. During the entire course constant reference is made to the application to practical ends of the knowledge gained. Not infrequently during the course a part of the laboratory period is devoted to a lecture. Occasional field trips are made. Because of the fact that there is not any single textbook adequate for this type of course all of the material is presented in lecture form, with references to works where more detailed information can be obtained.

As indicated earlier in the paper, the almost immediate results of this type of course in introductory entomology have been very striking and most gratifying. In short, an active and intelligent interest in entomology has been definitely created in a class composed of the average type of college student. This interest is, in the mind of the writer, a very significant thing. Altogether too frequently the student entering entomology enters it solely for the reason that he is attending a state college of agriculture because of the lower charges made there, although he may have no interest in agriculture. Therefore, he chooses the least of what to him are the necessary evils in the college, which in this case is entomology. This means that entirely too often we get a student whose interest is not primarily in entomology, or even in science, but who is merely searching for a job. We should be getting some of those excellent students who are enrolled in both the colleges of agriculture and colleges of arts and sciences of our universities who are scientifically inclined, but who do not know the nature of entomological work or the future in such a profession. In view of the ever-increasing need for sound scientifically trained entomologists it seems that we should make a conscious effort to present our subject to such students. It appears to the writer that this can be effectively done by giving such a course as the one described above. Furthermore, as also indicated ear-

lier in this paper, a course of this nature will supply to a very large extent that detailed scientific foundation for entomological students which appears to be so frequently lacking. Therefore, the writer feels that much good might be accomplished by introducing quite generally in our universities an elementary course in the biology of insects, along the lines described, to be required of all students intending to major in entomology, in order to insure a comprehensive foundation for later work, and to be open to the general academic students in order to create a more intelligent public interest in the subject and also to attract capable and desirable students to our profession who might otherwise be lost because of failure to present it to them in a favorable light in the beginning.

POOR RESULTS SECURED IN SOME PRELIMINARY AIRPLANE DUSTING OF PECANS FOR THE CONTROL OF THE PECAN LEAF CASE-BEARER

By G. F. MOZNETTE, *Bureau of Entomology, U. S. Department of Agriculture*

During the last two seasons experimental work has shown that fairly good results can be secured in the control of the pecan leaf case-bearer, *Acrobasis palliolella* Rag., by dusting with ground machines. Since past experimental work against pests of other crops has demonstrated that in the use of an airplane dust is distributed quite evenly, some experimental work was arranged in the spring of 1928 to ascertain what degree of control could be obtained for the pecan leaf case-bearer by the use of airplanes, and also to determine whether the method would be superior to dusting from the ground. The experimental work was arranged cooperatively between the Bureau of Plant Industry and the Bureau of Entomology of the U. S. Department of Agriculture, the former bureau being interested in ascertaining whether pecan scab could be successfully controlled. The airplanes for the work were furnished by the Delta Laboratory of the Bureau of Entomology at Tallulah, La., and were similar to those which are ordinarily used to distribute calcium arsenate in cotton dusting.

The results which were secured indicate no appreciable difference between the percentages of infested buds in the upper and lower portions of the trees in the dusted grove where counts were made and in the check. No marked difference was noted between the average numbers of hibernacula formed by the pecan leaf case-bearer about the buds in the dusted grove and in the check. In the dusted grove 20,465 buds were examined and 7,404 hibernacula were found, an average of

0.36 per bud; whereas on the check on a total of 6,844 buds examined 3,044 hibernacula were found, or an average of 0.44 per bud.

Considerable study is necessary along meteorological lines to determine what factors influence the action of the dust cloud over trees the size of pecans under different atmospherical conditions which may exist during the time of dusting. The dust cloud from the plane used in the tests followed a spiral course, but instead of coming down rapidly and penetrating the trees and covering the foliage there was a decided tendency for the dust cloud to rise and remain above the trees for some distance in the rear of the plane. As the dust cloud drifted and dispersed above the trees it gradually settled irregularly some six or more rows beyond the swath width. However, at times the tops of the trees in one or two rows immediately adjacent to the swath width, in the direction of the drift of the dust cloud, received some of the dust before it dispersed above the trees to any extent. On the mornings when the dustings of the grove were made there was a decreasing humidity and a rising temperature, and it may be that the action of the dust cloud is influenced by these meteorological conditions.

In dusting pecan trees 30 feet in height with a dust containing 10 per cent of lead arsenate, even when applied at the rate of 80 pounds to the acre, there is apparently too great a dispersion of the dust cloud to secure effective control against a pest like the pecan leaf case-bearer. This might be overcome by increasing the percentage of lead arsenate in the dust mixture.

The airplane duster used in the experiment was especially designed for the light dosages used in dusting cotton. Further changes are necessary in the construction of equipment adequate to deliver the larger dosages that are required in dusting trees the size of pecans.

RESULTS OF FURTHER INVESTIGATIONS WITH PARADICHLOROBENZENE AROUND PEACH TREES, WITH SPECIAL REFERENCE TO INJURY

By OLIVER I. SNAPP and H. S. SWINGLE, *U. S. Peach Insect Laboratory, Fort Valley, Georgia*

ABSTRACT

High temperatures in Georgia during October, 1928, caused a rapid generation of paradichlorobenzene gas, and as a result peach trees 1, 2, and 3 years old were severely injured. Some will die as a result of the treatment. Paradichlorobenzene dissolved in gasoline did not control the peach borer.

Laboratory and field experiments with paradichlorobenzene have been under way at Fort Valley, Georgia, for the last eight years. Special

attention has been given to the possibility of extending the use of this chemical to young peach trees, and to a study of tree injury under varying weather conditions.

Technical Bulletin No. 58 of the U. S. Department of Agriculture, which was issued in March, 1928, calls attention to severe injury to young peach trees from the use of paradichlorobenzene under the weather conditions that prevailed at Fort Valley, Georgia, during October, 1923. Severe injury to young peach trees occurred again in October, 1928, on account of high temperatures, which caused a rapid generation of paradichlorobenzene gas. October, 1928, was the warmest October in the last nine years in Georgia. This paper gives the results of the experiments of 1928, which substantiate those obtained in 1923. Agricultural experiment stations in at least five Southern States recommend paradichlorobenzene on 3-year-old trees, and some of these even recommend it on trees 1 and 2 years old.

Tree Injury from Paradichlorobenzene in 1928

The ¼-ounce dose was exposed for two and four weeks around trees 1, 2, and 3 years old. The ½-ounce and ¾-ounce doses were exposed for two and four weeks around 2-year-old and 3-year-old trees. The 1-ounce and 2-ounce doses were used for two and four weeks around 3-year-old trees. Four-year-old and 5-year-old trees were treated with the ¾-ounce dose for four weeks, and 6-year-old trees received the 1-ounce dose for six weeks. Plats of untreated trees were provided in orchards of each age, and these were examined at the same time as were the treated trees.

The following table gives a summary of the results obtained from the paradichlorobenzene experiments of 1928. No data on borer mortality are given in the table, as all borers below the crystal ring were killed by the dosages used.

One-year-old trees were severely injured from the 2 and 4 weeks exposures of the ¼-ounce dose. Some of these trees have died, and others will die. Practically all of the 2-year-old trees treated with the ¾-ounce dose will die. Those treated with the ¼ and ½ ounce doses were severely injured, some of which will die. The 3-year-old trees withstood the ¼ and ½ ounce doses fairly well, but the ¾-, 1- and 2-ounce dose caused severe injury. In 1923 the ½-ounce dose severely injured 3-year-old trees. Even though weather conditions in the fall of 1928 were very conducive to tree injury from paradichlorobenzene, there was not much injury to 4-year-old and 5-year-old trees from the ¾-ounce dose nor to the 6-year-old trees from the 1-ounce dose. In

most cases where injury occurred to trees of those ages it was confined to the bark layers. One of the 6-year-old trees showed rather severe injury, but not enough to affect its vitality seriously.

INJURY TO PEACH TREES FROM PARADICHLOROBENZENE APPLIED OCTOBER 11, 1928, AT FORT VALLEY, GA.

Age of trees	Size of dose	Period crystals exposed to trees	Number of trees	No. trees injured at termination of period of exposure: Severely injured into cambium	Moderate injury: Into cambium	Moderate injury: In bark layers	Severe into cambium	Flecking: In bark layers: Severe	Flecking: In bark layers: Moderate	Flecking: In bark layers: Light	Number of trees uninjured
Years	*Ounces*	*Weeks*									
1	¼	2	5	3	–	2	–	–	–	–	–
2	¼	2	5	–	–	–	2	–	2	1	–
2	½	2	5	[1]4	–	–	1	–	–	–	–
2	¾	2	5	[2]4	–	–	–	1	–	–	–
3	¼	2	5	–	–	–	–	–	–	1	4
3	½	2	5	–	–	–	1	–	–	1	3
3	¾	2	5	3	–	–	–	1	–	–	1
3	1	2	2	1	–	–	1	–	–	–	
3	2	2	2	1	–	–	–	–	–	–	1
1	¼	4	5	[3]4	1	–	–	–	–	–	–
2	¼	4	5	1	–	[4]2	–	–	–	1	1
2	½	4	5	1	–	–	1	–	1	2	–
2	¾	4	5	[5]5	–	–	–	–	–	–	–
3	¼	4	5	–	–	–	–	–	–	1	4
3	½	4	5	–	–	–	1	–	–	1	3
3	¾	4	5	2	–	[6]1	–	–	–	–	2
3	1	4	2	–	–	–	1	–	–	1	–
3	2	4	2	[7]2	–	–	–	–	–	–	–
4	¾	4	10	–	–	–	1	–	–	2	7
5	¾	4	10	–	–	–	1	1	1	3	4
6	1	4	5	[8]1	–	–	1	1	1	1	–
6	1	6	5	–	–	[9]2	–	–	–	–	3

[1]May die
[2]Will die.
[3]One severely injured.
[4]Severely injured.
[5]One will die.
[6]Will live.
[7]One lightly injured.

PARADICHLOROBENZENE DISSOLVED IN GASOLINE

During the fall of 1928 some experiments were conducted at Fort Valley, Ga., with paradichlorobenzene dissolved in gasoline for peach borer control, as suggested by Siegler and Brown (JOUR. ECON. ENT. 20: 701–702). Six-year-old trees were used for this work, and as they has been treated with paradichlorobenzene yearly from the time they were old enough for the treatment the borer infestation was light. A straight,

unblended, high-test gasoline was used as a solvent for the paradichlorobenzene crystals. The solution was applied in a circle around the tree, about one and one-half inches from the trunk. It was distributed as uniformly as possible. There was no previous preparation of the soil and no mound was raised after the application. The applications were made on October 11, the time recommended in this locality for the paradichlorobenzene treatment. The examinations for borer control and tree injury were made six weeks after the treatment. The results of these examinations were as follows.

Plat I. Check, untreated (5 trees). One three-fourths grown and one one-half grown live and active borers. No tree injury.

Plat II. Treatment with paradichlorobenzene crystals. With usual preparation and subsequent banking. Dosage, 1 ounce. Ten trees. Five one-half grown dead borers and one dead pupa. Seven of the trees showed a few flecks in the bark layers.

Plat III. Treatment with paradichlorobenzene dissolved in gasoline. Without previous preparation and without subsequent banking of the soil. Dosage, 1 ounce of crystals dissolved in 50 c.c. of gasoline. Five trees. One three-fourths-grown and one less than one-fourth-grown live and active borers. Also a great many live and active wood lice around one tree just below the level of the soil. No tree injury.

Plat IV. Solution treatment. Without previous preparation and without subsequent banking of the soil. Dosage, 1 ounce of crystals dissolved in 100 c.c. of gasoline. Five trees. Two one-half-grown live and active borers. No tree injury.

Plat V. Gasoline alone. Without previous preparation and without subsequent banking of the soil. Dosage, 50 c.c. Three trees. Two one-half-grown live and active borers. No tree injury.

Plat VI. Gasoline alone. Without previous preparation and without subsequent banking of the soil. Dosage, 100 c.c. Three trees. No borers and no tree injury.

Paradichlorobenzene dissolved in gasoline, and applied as described above, did not control the peach borer at Fort Valley, Ga., in October, 1928. This may have been due to the nature of the soil in this section, which was classified as Orangeburg clay by the U. S. Bureau of Soils in 1903.

Recommendations

Paradichlorobenzene should not be used on peach trees 1, 2, and 3 years old in the South. For 4-year-old and 5-year-old trees use the three-fourths-ounce dose of crystals for four weeks, and for trees 6 years of age and older use the 1-ounce dose of crystals for six weeks. Use only unadulturated paradichlorobenzene crystals of the fineness of granulated sugar or fine flakes.

THE MEXICAN FRUIT WORM SITUATION

By P. A. HOIDALE, *Harlingen, Texas*

Mr. Chairman, gentlemen, it is with real pleasure that I received an invitation from your Secretary to present a paper on the work which has been carried out against the Mexican fruit worm in the Lower Rio Grande Valley of Texas. In this paper I would like to bring out some of the results obtained and the factors that have been instrumental in achieving these results.

The area under quarantine comprises the counties of Cameron and Hidalgo, where the delta of the Rio Grande occurs, and Willacy. The climate is subtropical. The principal crops are citrus, truck and cotton. There are some orange trees that are known to be over fifty years old, but citrus culture on a commercial scale has been developed during the past ten or fifteen years. Last summer there were about three and one-half million citrus trees growing in the three counties. Approximately three millions of these trees were set out within the preceding four years. The Mexican fruit worm was discovered in the spring of 1927 by Doctor Thomas of the Texas Agricultural Experiment Station and his assistants of the Weslaco Substation feeding on the fruit of these trees. Subsequent inspection showed the infestation to be rather generally scattered over the Valley from Mission to Brownsville.

Federal and State Quarantines were promulgated shortly after the infestation was found. They aim at prevention of spread and complete eradication rather than control. Such eradication is being accomplished principally through the maintenance of a host free period from about March first to October first. During this time none of the known host fruits of the fly are allowed to reach a stage of maturity acceptable to the fly for oviposition. In addition to this the groves are kept in a sanitary condition throughout the shipping season by processing, burning or burying all drop fruit. The packing plants are also required to cleanup and destroy all cull fruit and debris. All fruit moves out of the quarantined area under permit and none is permitted to be moved from a grove or packing plant which was not kept in a sanitary condition. Naturally, all growers and packers keep their places clean.

Apparently these measures have been most successful in eradicating the pest from the quarantined area. Intensive inspections during the past two seasons have failed to reveal any recurrence of infestation. Yet, during the summer months, many specimens of Anastrepha can be secured from fruit grown in southern Mexico and offered for sale in the public markets of Matamoros and Reynosa. Our success in wiping

out the infestation was very largely the result of the wholehearted co-operation which was received from the people of the Valley. The opposition to the enforcement of the regulations has been insignificant.

The successful operation of this quarantine is based on several factors. In the first place, the preliminary work and publicity prior to the promulgation of the quarantines were perfectly handled by our good friend Mr. McDonald, formerly of the Texas Department of Agriculture. Consequently the citrus interests of the Valley saw in the quarantine not a hindrance to their industry but, in reality, an aid in ridding their groves of injurious insects and improving the marketing of Valley citrus by preventing the shipment of culls or insect-injured fruit. These people are vitally interested in citrus production. They believe that the future prosperity of the Valley rests largely upon this industry. They are, therefore, solidly behind any movement for the protection or improvement of this crop.

One of the most important factors in the success of the work was the immediate transfer of well trained inspectors to our new organization. Practically all of our district inspectors have had from 5 to 8 years' training with the pink bollworm field service. The area is divided into ten districts for administrative convenience. Each is in charge of an experienced man who is responsible for the proper enforcement of the regulations within his district. The district inspector is assisted by one or more assistant inspectors as needed. In this way the men have a definite territory under their control which has proved to make the work thoroughly agreeable and to produce satisfactory results.

Several natural and cultural factors work in our favor to maintain the host-free period. Citrus is the only fruit crop of any importance. Normally, only one crop of fruit is set each year which ripens during the winter months. Occasionally, when heavy rains fall in September or October, a small amount of "off bloom" fruit is set which would ripen during the summer months. However, this fruit is usually of a very poor quality and so no great difficulty is encountered in having it destroyed. None of the secondary host-fruits are raised on a commercial scale and a majority of the owners, after having the situation explained to them, voluntarily took the trees out.

The elimination of secondary host-fruit trees is a factor which will contribute greatly to the success of the host-free period. When operations began there were approximately 36,000 peach, plum and other host-fruit trees in the area. The quarantine requires that the owners remove the fruit from these trees before it reaches a ripening stage. With some 4,200 premises to watch and recheck, the amount of inspection

and follow-up work on the part of the inspectors, if this plan were to be followed literally, can be realized. It would mean constant annoyance throughout the summer months to the owners of these trees. Since it seemed, without reasonable doubt, that the quarantine would last longer than the normal life of these trees, it was decided that the logical thing to do was to rid the Valley of them. So a concerted effort was made through various channels to induce the owners to either destroy the trees or allow us to do so. The result is that today there are less than 300 of these trees on some 19 premises. It has never before been my pleasure to see such a community-wide spirit of cooperation and sacrifice as that shown by these people in the eradication campaign.

The citrus growers of the Valley are also deeply indebted to the officials and citizens of Mexico, particularly to those of the municipalities of Matamoros and Reynosa. The desirability of a cleanup of host fruits on the Mexican side of the border opposite the citrus growing area in Texas was discussed with the Mexican officials and citizens and met with an immediate and favorable response. The result was that they, in company with one of our inspectors, saw to the cleaning of all host trees beginning at the Gulf and extending about 100 miles up the river. It should be borne in mind that there is no commercial citrus crop on the Mexican side of the river and that this work on the part of the Mexican people was done in a spirit of friendliness and neighborliness toward the American growers.

To sum up the results which have been obtained up to the present time:

1. No infestation has been found in the crops of 1927–28 and 1928–29 despite intensive inspection throughout the area.

2. More than 99% of all secondary host fruit trees have been destroyed which assures the almost perfect maintenance of the host free period.

3. Orchards have been kept in much better condition and a better grade of fruit has been placed on the market since the inauguration of the quarantine.

These results have been obtained without appreciably interfering with the commercial production and movement of citrus.

The outlook for the future is most promising. With the elimination of the alternate host trees the almost perfect maintenance of the starvation period during the summer is assured. The growers are beginning to take pride in the sanitary condition of their groves and less and less trouble is experienced in getting the "drops" cleaned up and properly disposed of regularly during the winter months. Then, during the sum-

mer months when the infestation is heaviest in the fruit offered for sale in the Mexican markets, there is no acceptable fruit for the fly to feed on or oviposit in on the American side. Should a slight infestation develop on the American side during the winter months the chances are that the fruit in which the larvae were feeding would be destroyed as "drops" or culls before the larvae could enter the pupal stage. Even should an infestation manage to get by this control measure and also escape detection by our inspectors, it would be faced with the seven months starvation period before it could pass through more than two generations and would be then promptly wiped out.

INSECT PESTS AFFECTING COMMERCIAL CROPS IN THE LOWER RIO GRANDE VALLEY

By S. W. CLARK, *Entomologist, Lower Rio Grande Valley Experiment Station, Weslaco, Texas*

ABSTRACT

This paper discusses briefly the various insect pests affecting cotton, truck crops and citrus in the Lower Rio Grande Valley of Texas, the nature of control measures practised and some of the experimental results obtained at the Lower Rio Grande Valley Experiment Station.

The purpose of this paper is not to enter into a technical discussion of the various insects affecting commercial crops in the Lower Rio Grande Valley but merely to present the main pests and the nature and extent of control measures practiced in this locality.

The Lower Rio Grande Valley constitutes an area in the southeastern part of Texas lying along the Rio Grande river from the Gulf of Mexico west about 85 miles varying in width from approximately 25 miles at the eastern end to practically nothing at the western end. Practically all of this area is subject to irrigation. The elevation varies from about 30 feet at Brownsville to 65 feet at Mission. The climate is sub-tropical in nature.

The strategic location of the Valley with reference to new pests likely to appear cannot be overemphasized due to the fact of its close proximity to the Republic of Mexico and the prevailing southeast winds. It occupies also an important position relative to predictions of outbreaks of insects in the regions north of it, as insect pests, particularly those of cotton, usually appear first in this region.

Commercial crops in the Lower Rio Grande Valley can be divided into three main groups, namely, cotton, truck crops and citrus.

The insect pests attacking cotton in this section are mainly those pests affecting cotton in other regions with the exception of the cotton Bu-

calatrix, a new pest, which has recently made its appearance here. The Mexican cotton boll weevil is a pest in this region as elsewhere. Dusting with calcium arsenate is generally practiced and good control is received. Dusting with sulfur for control of the Cotton Flea Hopper is not so generally practiced although the growers are becoming more and more convinced of the value of this remedy.

The Cotton Leaf Worm, coming in from Mexico, is one of our most serious pests, not alone to cotton but to all truck crops. Many growers make no attempt to poison them in the hopes that with the loss of leaves more bolls will open. This perpetuates an abundance of worms which promptly, upon denuding the cotton plant of leaves, migrate to seed beds and set plants consuming them as they go. This past year was particularly bad in this respect and numerous plantings of early cabbage and other truck were ruined. In one district alone all truck crops set by one of the Cooperative Vegetable Unions were ruined with the exception of tomatoes and shallots. Considerable success was attained in halting this exodus of worms by using a dust mulch furrow around the field. The placing of post holes in these furrows increased their efficiency.

Among the pests we have affecting truck crops in general are cutworms and nematodes. The majority of the growers are using poison bran bait for cutworms and are having no trouble from this source. Nematodes are affecting carrots, tomatoes and beans particularly.

The bean leafhopper, with its transmission of bacterial blight, is a very serious pest to beans in this section and stands in a fair way to exterminate commercial growing of this crop unless the growers accept the inevitable, an intensive spray program. At the Valley station we have attained considerable success in their control by the use of bordeaux mixture-nicotine or sulfur. One of the oil sprays of low volatility combined with bordeaux gives some promise of being rather effective. The bordeaux-nicotine spray this year gave us, by far, the better results.

Infesting cabbage in the Lower Valley we have the cabbage aphis and cabbage looper. The nicotine-soap spray and arsenicals are generally used and these pests give us very little trouble.

The Harlequin cabbage bug is present but is not a serious pest except in occasional years to cabbage, probably due to the fact that considerable mustard is usually grown nearby which essentially constitutes a trap crop.

The cucurbits are attacked rather severely by aphis in this section. The use of nicotine dust is practiced rather spasmodically and numerous plantings are badly injured from the aphis. The reason for the lack of use of nicotine dust for control of aphis is the prevalence of very

windy days during the season of cucurbit growing which prohibit the material delivering practical control. The diabroticas are a serious pest in this section, both to cucurbits and other crops, and few attempts are made by the growers to control them.

The onion thrips and turnip louse are two pests affecting their respective hosts in a very serious manner in the Valley. Most growers have given up all attempts to control the thrips. At the Valley Station sowing the onions direct in the field has given some encouraging results and we are in hopes that this method combined with application of a quick breaking oil emulsion will give us practical control. Weather conditions are the factor which complicates the control of aphis on turnips. At the time turnips are starting we are in the midst of a rainy season with considerable wind and cool weather. The problem of aphis control is one which must yet be worked out.

Citrus, of which practically all farms have a planting, is affected by numerous scale insects of which are included California Red Scale, Purple Scale, Glover's Scale, Chaff Scale, Florida Red Scale, Soft Brown Scale, and Cottony Cushion Scale.

The Cottony Cushion Scale is more or less general over the entire Valley and it bids fair to become a more serious pest and necessitate introduction again of natural enemies. Growers usually show considerable interest in this pest and promptly take measures for its control.

The soft brown scale is primarily a pest of young citrus trees in the Valley and causes no concern as the majority of growers experience no difficulty in its control.

The three scales which present the most difficulty of control in the Valley are Purple Scale, Chaff Scale and California Red Scale. By far the most serious of these is the California Red Scale. The loss to the growers in the Valley from this one scale alone would run somewhat near $150,000 (estimate) for this year. Experiments conducted at the Valley station show rather conclusively that winter spraying or winter fumigation for control of this pest is of no benefit as reinfestation occurring during the summer months is sufficient to cause defoliation and loss of fruit crop unless prompt measures are taken to curb the infestation. At the present time two oil emulsion sprays applied in May and July seem to give most promise. Cleaner fruit, less defoliation and healthier trees have resulted from the use of oil sprays using an oil of low volatility applied in May and July than with any other materials at any other times. Fumigation with cyanide has given good results when used in August but at the present time the cost is prohibitive. The host plants of Red Scale in the Valley include the various forms of Citrus, Avocado,

Salt cedar (Tamarix), Oleander, Ligustrum, Euonymus, and Amoor River Privet.

There are several isolated infestations of Florida Red Scale in the Valley at the present time and they do not seem to spread although practically no measures are taken to exterminate them.

The Purple Scale, Glover's Scale, and Chaff Scale are wide-spread over the entire Valley and extensive damage results from their presence. Fair results are obtained in their control by following the method outlined for Red Scale and the rust mite.

The rust mite is a serious pest in this section. Most growers practice lime-sulfur spraying or sulfur dusting and excellent results are obtained. In groves given two dustings of sulfur, or two sprays of lime sulfur coupled with two oil sprays no trouble in their control is experienced.

Mealy bugs and white fly are unknown in the Valley and the possibility of their establishing themselves seems rather remote. Infestations of both these pests have occurred but for some reason or other have never become established.

Conditions peculiar to the Lower Rio Grande Valley necessitate continual vigilance on behalf of the growers in their attempts to control the various pests attacking their crops. As is true in any new developing country where an intensive system of agriculture is practiced, the problems of insect control are many and varied and an extensive research and educational program is fundamentally necessary before progress can be profitable and rapid.

SOME POSSIBLE MEANS OF CONTROL OF THE DAMAGE CAUSED BY THE COTTON LEAF WORM MOTH TO THE FIG

By FRANK M. HULL, *Texas Agricultural Experiment Station, Dickinson, Texas*

ABSTRACT

Damage to the figs is caused by periodic settling of swarms of moths on the fruit and souring of the figs as a result. A number of poison baits and repellents were tested out. Several poison baits gave promise of considerable success in the control of this pest. Repellents were not as effective. Experiments showed the time of greatest feeding of the moths to be just before dark.

In the region of Galveston and adjacent counties of the Texas coast, the fig industry is one which lends support to a considerable number of people. Between nine and ten thousand acres are involved (season 1928), and the industry is capitalized at approximately nine million dollars. There are eighteen canning factories in the section, six of which are in Galveston County. Beginning with the season of 1926, there began to

be signs of severe damage to the fruit by the moth of the cotton leaf worm (*Alabama argillacea*). However, the moth was known to have been injurious to a lesser extent for some years preceding 1926. This damage results from a periodic settling of large swarms of the moths on the fig orchards and a premature souring of the fruit by the feeding of the moths in consequence. The problem of finding suitable control measures for this insect occupied a part of the attention of the writer over the past two seasons of 1927 and 1928. These studies were conducted in part at the Angleton substation of the Texas Experiment Station, but chiefly at the Plant Lice Laboratory of the same station, located at Dickinson, Texas.

During the summer of 1926 there were several waves or outbreaks during the same season, culminating in one more severe than the others and roughly corresponding to the period of emergence of several broods of moths. In 1927 no outbreak occurred and the moths were not abundant in the fields. In 1928, however, many larvae of the moths were to be found in adjacent fields of cotton and a large number of pupae (some fifteen thousand) were collected and the moths allowed to emerge in cages for experiment. Only a small percentage of this number were available at any one time as the collections were made over a six week interval.

To reach the objective of cheap and efficient means of control, experiments along several lines were conducted. These were mainly trying out of possible repellents, a study of attraction to certain baits and also an attempt to measure the rate and amount of feeding. In consideration of the type of mouth parts, arsenical sprays certainly would not be expected to be of value; nor is it easily possible to reach the moths with contact insecticides. Therefore, baits, light traps, and repellents offer the main source of control measures.

Poison Bait Experiments

The poison used in baits was in all cases sodium arsenite at an equivalent rate of one-half pound to twenty-five pounds of bulk carrier. Carriers were bran, fig-mash, and fig and molasses syrups. The fig syrup is a fairly cheap by-product of the fig canneries, though not, of course, nearly as cheap as black strap molasses. The mashes and brans were encased in rough, slender sacks of cheesecloth not unlike a stocking and resembling Bologna sausage. Strips of flannel cloth and gunnysacking were soaked in these syrups and suspended from the top of the cage. One hundred moths were used to a cage and the number of moths dying each day was counted for three days. In each case the moths were

offered a choice of the bait or of a number of normal figs from the trees for feeding. The accompanying table shows the percentages of kill of the several baits.

TABLE 1

No.	Kind of Bait	No. Dead 1st Day	No. Dead 2nd Day	No. Dead 3rd Day	Total Dead 2nd Day	Total Dead 3rd Day	No. Sick 1st Day
1	Bran plus fig	34	48	—	82	—	22
2	Bran plus molasses	46	14	3	60	63	11
3	Figs cooked	54	13	5	67	72	5
4	Figs raw mash	78	17	3	95	98	2
5	Molasses syrup, flannel	4	12	22	16	38	1
6	Fig syrup, flannel strip	40	34	10	74	84	1
7	Fig syrup, gunny sack	11	51	28	62	90	12
8	Fig mash, flannel strip	68	10	5	78	83	4
9	Yeasty fig mash, gunny sack	86	5	6	91	97	0

All through the above series checks were run with moths caged with food but without access to poison. The percentages of natural death for these checks and for moths of the same age never exceeded three percent and was usually one or none. No repetitions of the above series were made, the material and time not permitting. The available time was devoted rather to finding indications of suitable methods and materials. However, numbers nine and four are to some extent repetitions of one another and the same may be said of numbers two and five. Number one was conducted or begun in the early morning and as this was found to be the time of least feeding the others were not begun until twilight, as obviously no good purpose can be served by allowing the baits to dry out unnecessarily during daylight hours. Number four was conducted to contrast with the cooked bait number three, in which the yeasts would presumably be destroyed. It is worthy of note that the yeasty-mash gave the highest first-day kill.

There seems to be a marked attraction to soured substances. In one instance, six cages were set up in an orchard, each cage covering a tree. The orchard in question was exceptionally clean and in which all fruit was picked before souring and the bases of the trees were kept unusually clean and free from grass. After two days the only soured fruit to be found was that within the cages and no moths could be observed within the orchard. It was noticed that the door of one cage was left about an inch ajar and observation showed a moth within. A search of the foliage revealed six or seven more, attracted there by sour fruit. A thorough examination of nearby uncaged trees was then made and a beating of

limbs and boughs revealed only one moth on seven or eight trees. This looks like a good case of attraction.

The degree of practicability of poison baits can only be determined by testing them during actual outbreaks, although, due to the accessibility of material for study, experiment can be carried on without such outbreak. Data has been obtained as to the average yield that the average grower may expect, over that period during which a fig moth outbreak is known to last. This period is stated to be approximately ten days and this is supported by the tests we have run of length of life of the moths. The maximum life without food being eleven days for one hundred moths. The analysis of a series of a dozen seasonal fig yields, show the average yield to be four thousand, eight hundred and fifty pounds, per acre per ten day period. At last season prices the greatest possible revenue the grower needs protected will amount to $24.50 per acre. Of course, the moth has never thus far taken 100 per cent toll. The damage or loss usually amounts to from 60 to 80 per cent. The three remaining things which must be known to determine the usuability of this material are—the amount and cost of the bait necesssary and the amount of time required to place this in operation in an orchard. It might not be necessary to bait each tree. Treatment of outside trees might alone be sufficient to stop the influx of moths. The more efficient baits might decimate the moths in one or two days time.

Repellents

The materials tested were emulsions of cade oil and pine tar oil. A number of moths (five hundred) were enclosed in a cage in which a series of figs were placed. The figs were fastened to a large panel-like piece of cardboard and a series of preliminary readings were taken of the rate of feeding of the moths, then the repellent was introduced and another series of readings taken. The pine tar oil showed greater repellent action over the cade oil. The effect of both wore off in less than 24 hours. There were some lingering traces of the repellent noticeable on the figs afterwards which, however, was removed by a minute's immersion in hot water, which is part of the canning process. Repellents, provided they prove effectual, would seem to stand a greater chance of being cheaper than baits, but it is likely that the labor of continuous reapplication would make them prohibitive. Poisoned baits have the advantage of reducing the number of moths.

Life of the Moths

In a cage with a hundred moths confined with abundant supply of soured figs, the last moth died in 27 days, giving an average of 3.7 daily. However, the average for the first 13 days of this period is 1.8. In the case of moths confined without food, the total number of days was 11 and the average demise 9.0. The average for the first five days was 10.30

Relation of Feeding to Light

A series of readings were taken in order to determine at what hour the maximum feeding of the moths takes place. Obviously, baits should be placed in the field just before this time, in order to obtain the best results. Accordingly, 500 moths were confined in a cage with fruit. The figs were fastened to a panel of heavy cardboard, in order to separate them and find room for the maximum number of moths to feed. The cage was then placed by an open window. Readings were taken of the total number moths resting on the fruit at each hour and likewise of the number of moths with proboscis resting on open end of fruit. In the table below, the first figure represents the total number on fruit and the second represents those pointed to open end of fruit.

Time	No. Moths on Figs	No. Moths on Open End of Fruit	*Time*	No. Moths on Figs	No. Moths on Open End of Fruit
1	0	0	1	17	1
2	3	0	2	15	1
3	3	0	3	15	1
4	2	0	4	13	3
5	2	0	5	12	1
6	14	3	6	10	0
7	26	5	7	10	0
8	21	4	8	10	0
9	20	1	9	9	0
10	18	2	10	11	0
11	18	1	11	9	0
12	17	2	12	11	0

The most interesting phase of the feeding habits lies in the apparent fact that feeding is intermittent and lasts for but a few minutes only. There seems to be a constant interchange of moths throughout the night. This is necessarily true in view of the fact that at a given time rarely over a dozen moths are feeding at once. In spite of this, the results of poisoned cages prove that the majority of moths have fed at least once during the night.

FURTHER TESTS OF CUTWORM BAIT POISONS

By CLAY LYLE, *A. & M. College, Miss.*

ABSTRACT

Using about 360 worms of five species in individual boxes containing the same food on which the worms were feeding when collected, it was found that a poisoned bait made of 1 pound of Paris green and 50 pounds wheat bran gave an average kill of 95% in 24 hours, in comparison with 53.6% kill with a sodium fluosilicate bait of the same proportions. When the sodium fluosilicate was completely dissolved in water before adding to the bran, the mortality was 44.8% in 24 hours.

During 1928 a comparison of Paris green and sodium fluosilicate in cutworm baits was made with about 360 worms of five species. Both poisons were used at the rate of 1 pound to 50 pounds wheat bran. The worms were deprived of food for about 24 hours, and then confined in large individual pill boxes containing, in addition to the poisoned bait, fresh leaves of the plant on which the worms were feeding when collected, thus allowing a choice of the poisoned bait or a favorite food plant. The species used were: *Agrotis ypsilon*, *Feltia annexa*, *Feltia malefida*, *Laphygma frugiperda*, and *Prodenia ornithogalli*. Analysis of the Paris green showed 55.12 per cent arsenic trioxide, while the sodium fluosilicate (V-C commercial) was 98 per cent pure.

The results were almost identical with those obtained by the writer in 1927 and reported in the October, 1928, issue of the JOURNAL OF ECONOMIC ENTOMOLOGY. In nearly all cases the Paris green killed a much greater percentage of the worms, and what is of equal importance in saving a crop, killed them much quicker. As it was suggested by Dr. Marcovitch of the Tennessee Experiment Station that the poor results from the sodium fluosilicate in the 1927 tests might have been due to the chemical not being sufficiently dissolved, a comparison was made in 1928 of baits containing this chemical mixed dry, and others in which it was completely dissolved (1 gram in 154cc of water) before adding to the bran. It was found that the dissolved sodium fluosilicate bait was somewhat sloppy for good distribution, and was slightly less effective than when the chemical was dry-mixed with the bran and the necessary water added later.

Detailed results are shown in the accompanying table. No comparison was made with *Feltia malefida*, as only five specimens were collected, and all were killed in 15 hours with Paris green bait.

EXPERIMENTS WITH CUTWORM BAIT POISONS

	No. of Worms in test	Mortality 15 hours	24 hours	48 hours
Paris green bait—				
Agrotis ypsilon	19	18	19	—
Feltia annexa	10	9	10	—
Feltia malefida	5	5	—	—
Prodenia ornithogalli	7	7	—	—
Laphygma frugiperda	100	88	94	99
Total	141	127	134	140
Average mortality		90%	95%	99.3%
Sodium fluosilicate bait—				
Agrotis ypsilon	15	10	10	15
Prodenia ornithogalli	7	7	—	—
Laphygma frugiperda	75	22	35	49
Total	97	39	52	71
Average mortality		40.2%	53.6%	73.2%
Sodium fluosilicate bait (dissolved)				
Agrotis ypsilon	15	9	9	14
Feltia annexa	10	6	6	7
Laphygma frugiperda	100	27	41	53
Total	125	42	56	74
Average mortality		33.6%	44.8%	59.2%

THE INFLUENCE OF EXTERNAL TEMPERATURE ON THE HIVE TEMPERATURES DURING THE SUMMER

By W. E. DUNHAM, *The Ohio State University*

ABSTRACT

The purpose of this experiment was to study the variations in temperature occurring within different regions of a hive during summer and to explain if possible to what the variation is due.

The writer wishes to express his sincere appreciation to Dr. W. M. Barrows for his kind guidance and encouragement in every phase of the work.

PROCEDURE

A normal colony of medium strength was selected for this experiment. This colony had a moderate supply of honey and of pollen; the number of worker bees was about 30,000; brood-rearing was normal; and the queen's capacity for egg-laying was average or a little below. Such a colony in a ten frame standard hive was so placed in a room that it was

adjacent to a window. From this hive an extension of the entrance was made which ended out-of-doors in a four by a three-eighth inch opening. This allowed the bees to carry on their normal activities such as gathering nectar, pollen, water, etc.

The thermocouple method for determining the temperatures within the hive was used. By the use of thermocouples, temperatures in the hive could be obtained without approaching the hive, thus eliminating the possibility of disturbing the bees. The old method of taking temperatures with thermometers often disturbed the bees; this resulted in greater muscular activity and consequently higher temperatures. There were eight thermocouple wires running into the hive at equally distributed locations but all were placed at the same depth which was four and one-half inches from the top of the hive. Beginning August 20th, and extending to September 1st, temperatures were taken every hour from each wire, making a total of 2,304 readings taken in the hive during

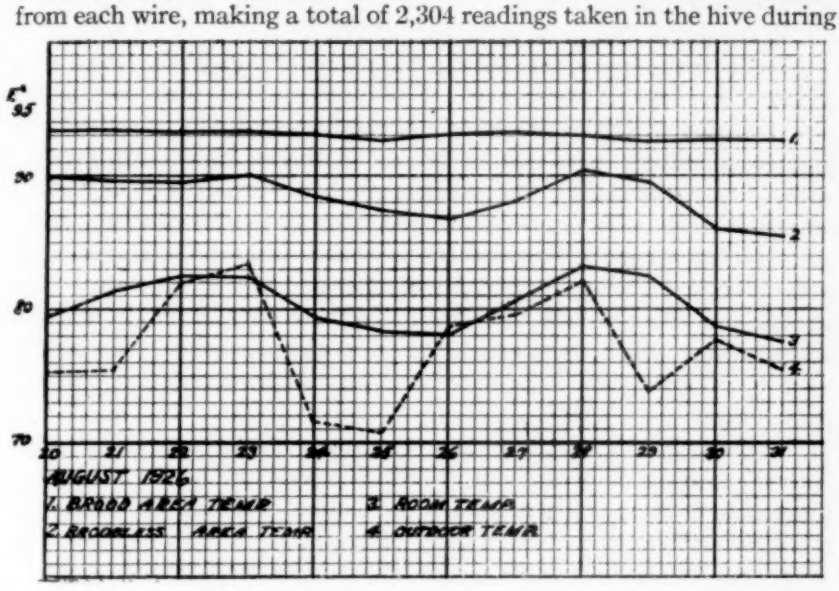

FIG. 39—Graph showing temperatures obtained.

the period of the experiment. The data gathered were arranged in tabular form for each day showing the average daily temperature of the portion of the hive unoccupied by brood, the average daily temperature of the portion of the hive occupied by brood, the average daily outdoor temperature, and the average daily room temperature. The curves which are shown in Fig. 39 give a graphic picture of the temperatures which were obtained.

Discussion

On August 19th, the day before this experiment was started, each frame of the hive was examined and notes taken on the exact position of the honey, brood, and empty comb space. On September 1st, at the close of the experimental period, the frames were again examined in reference to the points already mentioned. The amount of brood present at this time showed a very slight increase over the amount present at the beginning of the experiment. There were five frames of brood on August 19th and on September 1st the amount had increased to five and one-fourth frames.

Before any conclusions could be drawn from the data gathered, the temperatures had to be grouped into two distinct classes: those occurring in the brood area, and those occurring in the broodless area. In the following discussion it must be remembered that some heat is given off by the brood due to its metabolic activity.

As seen in the curve, the daily average temperature of the brood area shows a remarkable constancy. It is quite evident then that where brood-rearing activities are going on, the bees maintain a rather constant temperature, and that variations in the external temperatures, such as occurred during this experiment, had very little if any effect on the average daily temperatures occurring in the brood area. However, it is interesting to note that the two low average daily temperatures within the brood area occurred August 25th and 31st; on the same days the two low average daily temperatures representing the environmental temperatures which surrounded the hive also occurred. This would seem to indicate that there may be a very slight correlation between these curves.

In comparing the average daily temperature of the broodless area with the average daily temperature which represents the environmental temperature, there is a remarkable correlation. As seen by comparing these two curves, the average daily temperature of the broodless area drifts proportionally with the rise or fall of the external temperature.

Drawing from the general experience of beekeepers, there are several factors which may help to explain the relationship between the average daily temperature of the broodless area and the average daily external temperature. When there are many bees in the broodless area, and when the bees are not stimulated to any excessive activity, the average daily temperature of the broodless region will drift in proportion to the external temperature, but the number of degrees between the two curves will be much greater than where there are fewer bees in the broodless

area. To state this in another way, when the number of bees in the broodless area is not large and when the bees are not stimulated to excessive activity the average daily temperature of this region will correspond more closely with the average daily external temperature than where the colony is strong. Obviously when there are many bees in the broodless area and conditions are similar to those already stated, the heat produced by the activity of them would be greater than the heat produced by fewer bees occupying the same amount of broodless area. However, when the bees are stimulated to greater activity due to a pollen or a honey flow, the range in degrees between the average daily temperature of the broodless area and the average daily external temperature would be greater in both the strong and the weak colony than in the afore-mentioned case. The increased muscular activity brought about by a pollen or a honey flow always results in an increase in the temperature of the broodless area.

SUMMARY

The average daily temperature of the brood area is quite constant. The average daily external temperatures, such as occurred during this experiment, had very little if any effect on the average daily temperatures occurring in the brood area. The average daily temperature of the broodless area drifts proportionally with the rise or fall of the external temperature.

TECHNIQUE EMPLOYED IN TRANSFERRING PARASITES OF THE ORIENTAL PEACH MOTH (*LASPEYRESIA MOLESTA* BUSCK.)

By DERRILL M. DANIEL, *Experiment Station, Geneva, N. Y.*

ABSTRACT

Results of two methods of handling parasitized oriental peach moth material in transferring *Macrocentrus ancylivora* Rohwer are given. Retention of the material at the point of collection until the pupal stage is reached is considered the better of the two methods.

With the advent in 1927 of the oriental peach moth into the peach and quince area of Niagara county, N. Y., methods of combating this pest were of prime concern. Since it was agreed that the use of parasites was the most hopeful undertaking, it was decided to attempt the importation and establishment of promising parasitic species. The object in mind was to build up artificially a parasite population in this newly infested area.

Published data and correspondence with Dr. Peterson revealed the fact that *Macrocentrus ancylivora* was the most effective species in southern New Jersey. Thru the cooperation of Dr. Peterson and his assistants and the Department of Farms and Markets of New York the transfer of this species was made possible. This paper summarizes the data on the methods employed in transferring this parasite from New Jersey to western New York and may be of interest to other entomologists contemplating the importation of this or other species parasitic on the oriental peach moth.

Peach twigs appearing to contain oriental peach moth larvae were collected from orchards in the immediate vicinity of Moorestown, New Jersey, and taken to the adjacent laboratory. The leaves were stripped from these twigs, some of the latter were wrapped in paper towels, placed in mailing cases and mailed to the Vineyard Laboratory at Fredonia, New York. On their arrival the twigs were removed and placed on apples in battery jars. The twigs left at Moorestown were likewise placed on apples in battery jars. As the twigs dried the larvae emerged and completed their feeding in the apples. Corrugated cardboard strips were placed in the jars so that the larvae could spin their cocoons after feeding was completed. The larvae were not removed from the twigs at either place, but were permitted to emerge in a normal manner. This method effected a considerable saving in time.

Tables 1 and 3 show the records for the material mailed to Fredonia, while Tables 2 and 4 give those for the material retained at Moorestown until the larvae had pupated. A comparison of Tables 1 and 2 shows that with twigs mailed to Fredonia there was a total emergence of 15.03 per cent and of these 48.56 per cent were parasites. Of the twigs retained at Moorestown there was a total emergence of 32.42 per cent of which 68.69 per cent were parasites. Therefore, not only was the total percentage of emergence higher on the twigs retained at Moorestown, but the percentage of parasites was also much higher. A comparison of Tables 3 and 4 shows that the differences noted above were not due to dates of collection or to difference of the orchards from which collections were made, as the twigs in both series were collected over approximately the same period and from the same orchards. It is concluded, on the basis of this experience, that the better method of handling this parasitic material is to allow the material to remain at the point of collection until the larvae have reached the pupal stage.

TABLE 1. MAILING CASE RECORDS (Twigs mailed to Fredonia, N. Y.)

Mailing case number	Number twigs	Number OPM emerged	Number Macrocentrus emerged	Total emerged	Percentage emerged	Percentage parasitism	Date collected	Orchard number
1	100	41	40	81	81.00	49.38	June 8 1928	1
2	75	00	0	00	0.00	0.0	8	1
3	100	1	0	1	1.00	0.0	8	3
4	100	5	6	11	11.00	54.54	9	1
5	100	3	4	7	7.00	57.14	9	1
6	100	2	5	7	7.00	71.42	9	2
7	100	3	9	12	12.00	75.00	9	2
8+17	200	7	15	22	11.00	68.18	11	4
9	100	5	12	17	17.00	70.57	11	4
10	100	2	12	14	14.00	85.71	11	4
11+27	200	5	23	28	14.00	82.14	11	4
12	100	2	12	14	14.00	85.71	11	4
13	100	5	13	18	18.00	72.22	11	4
14	100	0	2	2	2.00	100.00	11	4
15	100	2	14	16	16.00	87.50	11	4
16+18	200	5	35	40	20.00	87.50	11	4
19+25	200	8	25	33	16.50	75.75	12	5
20+23	200	10	29	39	19.50	74.35	12	5
21	100	5	5	10	10.00	50.00	12	5
22	100	7	23	30	30.00	76.66	12	5
24	100	1	4	5	5.00	80.00	12	5
26	100	0	0	0	0.0	0.0	12	4
28	100	9	8	17	17.00	47.05	13	6
29	100	6	5	11	11.00	45.45	13	6
30	100	1	3	4	4.00	75.00	13	6
31	100	3	19	22	22.00	86.36	13	6
32	100	3	9	12	12.00	75.00	14	7
33	100	2	7	9	9.00	77.79	14	7
34	100	2	4	6	6.00	66.67	14	7
35	100	11	4	15	15.00	26.67	14	7
36+38	200	15	23	38	19.00	60.52	14	7
37	100	7	7	14	14.00	50.00	14	7
39	100	4	10	14	14.00	71.43	14	7
40	100	15	7	22	22.00	31.81	15	8
41	100	10	3	13	13.00	23.07	15	8
42	100	13	6	19	19.00	31.57	15	8
43	100	6	6	12	12.00	50.00	15	9
44	100	12	8	20	20.00	40.00	15	9
45+53	200	28	5	33	16.50	15.15	15	9
46+59	200	3	5	8	4.00	62.50	15	9
47	100	25	10	35	35.00	28.57	15	9
48	100	13	3	16	16.00	18.75	16	11
49	100	15	1	16	16.00	6.25	16	11
50	100	14	1	15	15.00	6.67	16	10
51	100	15	2	17	17.00	11.76	16	10

TABLE 1. CONTINUED

Mailing case number	Number twigs	Number OPM emerged	Number Macrocentrus emerged	Total emerged	Percentage emerged	Percentage parasitism	Date collected	Orchard number
52	100	9	3	12	12.00	25.00	16	10
54	100	8	1	9	9.00	11.11	16	10
55	100	0	0	0	0.0	0.0	16	10
56	100	20	0	20	20.00	0.0	16	10
57+62	150	25	3	28	18.66	10.71	16	10
58	100	22	2	24	24.00	8.33	16	10
60	100	0	0	0	0.0	0.0	16	10
61	100	15	1	16	16.00	6.25	16	10
63	111	32	1	33	29.72	3.03	20	10
Totals	6236	482	455	937	15.03	48.56		

TABLE 2. JAR RECORDS (Twigs retained at Moorestown, N. J.)

Jar number	Number twigs	Number OPM emerged	Number Macrocentrus emerged	Total emerged	Percentage emerged	Percentage parasitism	Date collected	Orchard number
1	100	12	36	48	48.00	75.00	June 9, 1928	1
2	100	3	22	25	25.00	88.00	9	1
3	100	10	27	37	37.00	72.97	9	2
4	82	10	16	26	31.71	61.54	9	1
5	100	13	22	35	35.00	62.86	10	2
6	100	11	22	33	33.00	66.67	10	2
7	100	3	15	18	18.00	83.33	10	2
8	100	0	19	19	19.00	100.00	10	2
9	100	5	13	18	18.00	72.22	10	2
10	95	3	19	22	23.16	86.36	10	2
11	150	4	38	42	28.00	90.47	11	4
12	150	5	33	38	25.33	86.84	11	4
13	159	8	36	44	27.67	81.82	11	4
14	150	6	41	47	31.33	87.23	12	4
15	150	13	28	41	27.33	68.29	12	4
16	150	6	47	53	35.33	88.68	12	4
17	150	9	39	48	32.00	81.25	12	4
18	150	8	57	65	43.33	87.69	12	4
19	150	21	39	60	40.00	65.00	12	4
20	37	2	17	19	51.35	89.47	12	4
21	200	15	42	57	28.50	73.68	13	2
22	225	39	48	88	39.11	54.54	13	2
23	200	18	34	52	26.00	65.38	14	6
24	200	32	55	87	43.50	63.22	14	6
25	196	27	47	74	37.76	63.51	14	6
26	270	88	4	92	34.07	4.35	15	10
Totals	3664	372	816	1188	32.42	68.69		

TABLE 3. MAILING CASE RECORD (Twigs mailed to Fredonia, N. Y.)

By Orchards			By Date of Collection		
Orchard number	Percentage emergence	Percentage parasitism	Date collected	Percentage emergence	Percentage parasitism
1	26.40	50.51	June 8	29.81	48.78
2	9.50	73.68	9	9.25	64.86
3	1.00	0.0	11	14.25	80.70
4	13.15	80.07	12	14.63	73.50
5	16.71	73.50	13	13.50	64.81
6	13.50	64.81	14	13.50	59.25
7	13.50	59.25	15	16.20	30.86
8	18.00	29.63	16	13.84	9.83
9	15.43	31.48	20	29.72	3.03
10	14.99	8.04	—	——	——
11	16.00	12.50	—	——	——

TABLE 4. JAR RECORD (Twigs retained at Moorestown, N. J.)

By Orchards			By Date of Collection		
Orchard number	Percentage emergence	Percentage parasitism	Date collected	Percentage emergence	Percentage parasitism
1	35.16	74.74	June 9	35.60	74.26
2	29.20	69.42	10	24.37	75.86
4	32.73	82.06	11	27.02	86.29
6	35.73	63.85	12	35.54	80.48
10	34.07	4.35	13	34.12	62.07
—	——	——	14	35.74	63.85
—	——	——	15	34.07	4.35

OBSERVATIONS ON SOME OF THE MORE IMPORTANT INSECTS CAPTURED IN CODLING MOTH TRAP BAITS

By M. A. YOTHERS, *Associate Entomologist, Bureau of Entomology, United States Department of Agriculture*

ABSTRACT

In capturing the codling moth, *Carpocapsa pomonella* L., in trap baits in orchards in the Yakima Valley of Washington, many other insects of different kinds were also taken. Records of the number of individuals of several species and groups captured are discussed and presented in tabular form.

In any experiments made with trap baits for attracting and capturing the codling moth (*Carpocapsa pomonella* L.) many insects of several other kinds are invariably caught. Certain kinds are captured in such numbers that they interfere with the most efficient use of the baits for the primary purpose. Not only injurious but also beneficial insects are attracted and in such numbers that it is often a question how much good is being done and how much harm. The purpose of this paper,

however, is not to enter into this discussion but to present, largely as a matter of record, the results obtained in the capture of various kinds of insects, and to show the distribution of these insects throughout the season or such periods as were covered in the experiments.

The insects hereinafter discussed were not all that visited the trap baits. Occasionally a few Vespas, large Diptera, grass moths, many small Diptera, and rarely grasshoppers, syrphus flies, butterflies and membracids were captured along with the others.

Manner of Using Trap Baits

In general the baits, of whatever nature, were suspended in the several kinds of containers by a hop cord run through a screw-eye inserted in a horizontal limb in the topmost part of the fruit trees. The following containers were used: wide-mouth quart fruit jars, 1½ gallon tin pails, 2-quart "milk kettles" (tin pails 5 inches in diameter with necks 3 inches in diameter), and 2-quart enameled kettles measuring about three inches deep and eight inches in diameter.

Formulas for Trap Baits

Apple Ferment: To make 6 gallons of apple ferment 3 pounds of apples were ground through a food chopper and cooked in 3 gallons of water. After being thoroughly cooked they were removed from the fire and 3 more gallons of water added, about 3 pounds of brown sugar, and at least 6 cakes of fresh yeast. The mixture was allowed to ferment for at least 5 or 6 hours and it was then ready for use.

Honey and Molasses Ferments: These are made by diluting honey or molasses with about 10 parts of water and adding about one cake of yeast to each gallon of the dilution.

Because of evaporation it is necessary to replenish these baits every 5 or 6 days, but in most experiments the bait was replenished at the time of each examination, or every 3 days.

The baits were all operated in a part of a fairly old apple orchard which had a scant alfalfa cover crop and a considerable growth of weeds and miscellaneous vegetation.

One of the main experiments conducted with trap baits for capturing the codling moth in 1926 was one planned to determine the value of these baits as a supplementary control measure against this insect.[1] A block of 42 trees, situated in the middle of one side of an orchard of fairly old

[1] Yothers, M. A. Summary of Three Years' Tests of Trap Baits for Capturing the Codling Moth. Journal Ec. Ent. 20: P. 567–575, 1927.

apple trees, was set aside as a bait test block, sprayed the same as the remainder of the orchard and in addition each tree was baited with apple ferment in a wide-mouthed, glass quart fruit jar. These jars were filled nearly full of the diluted apple juice on April 16, examined and the accumulated insects removed and new bait added every 3 days until Sept. 23. The season was unusually early, consequently the baits were started at least two or three weeks earlier than they would have been in an average year. When the test was started nearly all the apple blossoms were already off, and by the 20th of April all were off and the calyx spray application was being made. Conducted thus regularly throughout the season, the results should show something of interest and value as to the presence of the various insects captured in addition to the codling moth.

The chrysopas (Table 1) were few in numbers until early in July, after which they were present in more or less increasing numbers, with a maximum in early September, after which they fell off rapidly until the end of the season.

The clover-hay moth (*Hypsopygia costalis* Fab.) began visiting the baits the last of May, reached a maximum July 10, and gradually decreased to the end of the experiment.

The oblique-banded leaf-roller (*Cacoecia rosaceana* Harr.) appears to have been present from about May 20 throughout the season, but in very scant numbers.

The record of capture of noctuids seems to show an indication of a first brood for one or more species ending about June 19 with a maximum about May 11, and a second brood from June 19 to the end of the season with a maximum in late August and early September. Noctuids were present in greater numbers than any other insect at the termination of the test.

Bees were captured only during the first few days after the blossoms had fallen.

No codling moths were captured during the first few days, but from April 26 to September 20 they were present in more or less numbers depending upon the condition of the brood and the temperature. On account of the depressions in temperature, some of which are more pronounced than the depressions between the broods, there are apparent many irregularities in the number of codling moths present. The spring brood was probably over about the first of July. In late August and throughout September there was probably a combination of first and second broods.

TABLE 1. THE NUMBERS OF INSECTS OF DIFFERENT KINDS CAPTURED AT 3-DAY INTERVALS IN CODLING-MOTH TRAP BAITS IN PLAT C, YAKIMA, WASH., APRIL 19 TO SEPTEMBER 23, 1926

Bait used: Apple ferment

Date	Chrysopa spp.	Clover-hay moths	Oblique-banded leaf-roller moths	Noctuids	Bees	Codling moths	Temperature* Daily means for each 3 days averaged
April 16	—	—	—	—	—	—	—
17	—	—	—	—	—	—	—
18	—	—	—	—	—	—	—
19	0	0	0	9	7	0	66° F.
23	1	0	0	7	95	0	51.9
26	3	0	0	11	70	7	54.8
29	10	0	0	28	6	52	68.7
May 2	10	0	0	140	1	71	64.7
5	7	0	0	67	0	48	57.8
8	0	0	0	58	0	4	47.
11	4	0	0	383	0	33	51.3
14	3	0	0	171	0	132	65.8
17	3	0	0	68	0	20	58.3
20	0	0	1	26	0	14	60.8
23	1	0	0	16	0	42	57.5
26	4	0	1	21	0	8	53.2
29	1	1	0	34	0	4	56.2
June 1	1	0	2	44	0	13	57.2
4	6	2	2	57	0	32	65.5
7	15	30	1	18	0	160	73.5
10	0	8	8	41	0	74	72.8
13	2	3	1	25	0	21	62.
16	0	1	1	15	0	2	63.5
19	5	4	0	6	0	72	66.5
22	3	54	0	41	0	17	63.7
25	9	253	2	32	0	79	77.7
28	9	132	1	67	0	47	78.3
July 1	7	151	2	76	0	27	76.8
4	3	303	3	84	0	18	75.3
7	13	436	4	59	0	29	86.3
10	35	615	3	128	0	33	75.2
13	2	457	3	63	0	27	85.3
16	39	361	1	54	0	32	76.3
19	63	185	0	130	0	86	69.7
22	67	376	0	111	0	109	65.3
25	79	395	1	89	0	182	72.3
28	91	205	0	84	0	123	70.
31	71	266	0	55	0	172	72.

TABLE 1 CONTINUED

Bait used: Apple ferment

Date	Chrysopa spp.	Clover hay moths	Oblique-banded leaf-roller moths	Noctuids	Bees	Codling moths	Temperature* Daily means for each 3 days averaged
Aug. 3	96	149	0	71	0	169	71.
6	61	161	0	70	0	118	71.2
9	104	131	1	117	0	282	74.8
12	75	176	1	153	0	148	7.3
15	100	138	0	320	0	359	72.8
18	36	34	1	104	0	125	71.8
21	44	40	3	185	0	43	65.
24	100	132	8	492	0	226	66.3
27	63	62	2	300	0	144	75.7
30	68	62	1	567	0	68	68.
Sept. 2	115	46	2	285	0	46	63.7
5	264	36	4	765	0	122	66.
8	126	50	0	530	0	65	67.5
11	232	33	1	662	0	92	64.2
14	183	45	1	476	0	110	61.3
17	43	7	1	133	0	21	57.8
20	11	1	0	117	0	4	51.5
23	10	3	0	40	0	0	52.8
Total	2,298	5,544	63	7,705	179	3,932	

*The temperature is the average of the mean daily temperature for each 3-day period *preceding* date of examination.

In addition to the experiments recorded in Table 1, eleven other experiments with various kinds of baits and bait containers were conducted during the spring brood of the codling moth. These tests tend to confirm the results presented in Table 1. The earliest insects were captured in these tests as follows: chrysopas, April 26; clover-hay moths, May 26; oblique-banded leaf-roller, May 23; noctuids, April 23; honey bees, April 19; and codling moths, April 26. According to these tests, however, but few chrysopas appeared until late June and early July. Clover-hay moths were numerous by the middle of June. Only occasional leaf-rollers were captured at any time, about as shown in Table 1. Noctuids were present from the start, April 17. In each of the 6 experiments running to July 4, there was a decline in the number of codling moths captured until that date, which corroborates the results in Table 1 that this was about the end of the spring brood.

In two tests during the first and second broods of the codling moth, one running from July 10 and the other from July 22, and both continuing to Sept. 23, the chrysopas were captured in considerable numbers throughout most of this period although there was an abrupt falling off in numbers caught after the middle of September. Clover-hay moths were captured in greatest numbers during July, but few after the middle of September. Leaf-rollers appeared in these tests also very rarely, but with an increase from 0 to 6 per day to 12 per day for the last week of August. Noctuids were in greatest abundance during the last week of August and the first week of September. The number of codling moths was on the increase until about the 25th of July, after which they were present in considerable numbers, with the exception of August 18–21 and Sept. 2, until their rapid decline, accompanied by a considerable drop in temperature, on and after September 11.

Another experiment made to compare several kinds of baits, bait containers, etc., was run from July 10 to Sept. 23, during the first and second broods of the codling moth (Table 2). These baits are listed as

TABLE 2. THE NUMBERS OF INSECTS OF DIFFERENT KINDS CAPTURED AT 3-DAY INTERVALS IN VARIOUS KINDS OF CODLING-MOTH TRAP BAITS IN PLAT A, DIRECTED AGAINST THE FIRST AND SECOND BROODS, YAKIMA, WASH., 1926

(July 10–Sept. 23)

Bait	Container	Chrysopa spp.	Clover hay moths	Oblique-banded leaf-roller moths	Noctuids	Codling moths	Total insects caught
Apple ferment, cooked	jars	227	1,006	4	959	468	2,664
Apple ferment, raw	jars	146	372	5	562	190	1,275
Apple ferment, cooked	pans	496	1,836	13	1,315	807	4,467
Apple ferment, raw	pans*	347	475	9	499	398	1,728
Apple ferment, cooked	pails	494	1,035	17	804	424	2,774
Apple ferment, raw	pails*	246	200	1	174	119	740
Apple ferment, cooked, diluted 50/50	pans	291	516	5	673	174	1,659
Apple ferment, raw, diluted 50/50	pans	399	515	13	842	370	2,139
Molasses ferment	jars	233	935	5	1,128	424	2,725
Molasses ferment	pans	782	1,597	19	2,078	957	5,433
Apple ferment, cooked, diluted 1 to 2	jars	174	379	0	909	193	1,655
Vinegar, 10 per cent	jars	24	129	3	91	62	309
Honey ferment	jars	266	816	0	926	309	2,317
Honey ferment	pans	647	1,779	11	1,777	318	4,532
Total		4,772	11,590	105	12,737	5,213	34,417

*Three containers only, all others have four.

they were located in the orchard. There were four containers in all cases except tests 4 and 6, where there were but three owing to absence of trees. In comparing the cooked and raw apple ferments in the various containers, it will be noticed that in nearly every case more insects were captured in the cooked than in the raw ferment. Molasses ferment in pans caught many more insects than did the jars, which also held equally true of the honey ferment. The vinegar proved the least satisfactory of any of the baits tested.

TABLE 3. COMPARISON OF THE THREE MOST EFFICIENT BAITS AND CONTAINERS USED IN CAPTURING THE DIFFERENT KINDS OF INSECTS IN THE CODLING-MOTH TRAP BAITS, IN PLAT A, DIRECTED AGAINST THE FIRST AND SECOND BROODS, YAKIMA, WASH., 1926

Insect	Number caught	Kind of bait	Container
Chrysopa	782	Molasses ferment	pans
spp.	647	Honey ferment	pans
	496	Apple ferment, cooked	pans
Clover-hay	1,836	Apple ferment	pans
moths	1,779	Honey ferment	pans
	1,597	Molasses ferment	pans
Oblique-	19	Molasses ferment	pans
banded	17	Apple ferment, cooked	pails
leaf-roller	13	Apple ferment, raw, diluted 50/50	pans
moths	13	Apple ferment, cooked	pans
Noctuids	2,078	Molasses ferment	pans
	1,777	Honey ferment	pans
	1,315	Apple ferment, cooked	pans
Codling	957	Molasses ferment	pans
moth	807	Apple ferment, cooked	pans
	468	Apple ferment, cooked	jars

In Table 3 are shown the three best baits and containers for capturing the several kinds of insects. Molasses ferment, apple ferment, and honey ferment are the three best baits found in these experiments, and the enameled kettles or pans are the best containers. Most chrysopas, noctuids, leaf-roller moths, and codling moths were captured in the molasses ferment in pans. Clover-hay moths, however, seemed to prefer the apple ferment and then the honey ferment before the molasses ferment. Jars appear among the three best containers only once as best and once as third best. Pails in only two comparatively insignificant cases are shown as among the best, but pans are superior to all others even to the second and third place.

A STUDY OF THE INSECTICIDAL PROPERTIES OF SOAPS AGAINST THE JAPANESE BEETLE

By P. A. VAN DER MEULEN, *Agent*, and E. R. VAN LEEUWEN,
Associate Entomologist, Japanese Beetle Laboratory, U. S. Department of Agriculture, Moorestown, N. J.

INTRODUCTION

The insecticidal properties of soaps have been recognized for many years, and these substances have found extensive application against many different kinds of insects. Certain preliminary results obtained with sodium oleate, which indicated that soap solutions are effective against the adult Japanese beetle, led the authors to undertake a systematic study, with a view to finding the most effective soap, and also to determine, if possible, what the mechanism of the insecticidal action of soaps is, in this case. The present paper contains the results obtained by the use on the beetle of a number of different sodium and potassium soaps. The immediate object was, in all cases, to ascertain the per cent of adult beetles killed when different soaps were used, under conditions maintained as nearly constant as possible.

MATERIALS USED

The oils and fats from which the soaps were made were chosen in such a way as to give as representative a selection as possible. They include both animal and vegetable products, belonging to the various groups of drying, semi-drying, and non-drying oils.

PREPARATION OF MATERIALS

The soaps were prepared from the oils and fats by saponifying with sodium hydroxide solution, separating the unsaponifiable material, and acidifying the soap solution with dilute sulfuric acid. The separated fatty acids were washed repeatedly with hot water. Finally, a suitable portion was weighed and treated with the calculated quantity of sodium or potassium hydroxide, which was dissolved in water. The solutions were warmed until homogeneous, and placed in glass jars provided with a glass top and a rubber seal. These stock samples consisted of about 450 grams of soap and approximately 1000 grams of water. In testing these materials to determine their insecticidal value and their physical properties, portions of the stock solution were weighed on a balance, added to the proper quantity of water, and stirred at the prevailing temperature until completely dissolved, or until the solution was saturated. In most cases, solutions could be prepared which contained as much soap as corresponds to six pounds to 50 gallons of water, but with a few of the soaps the solubility was too low for this. Nevertheless, the solution was used in these cases with some of the soap in suspension.

Cage Experiments

All of the experiments were made under small-cage conditions. Approximately 100 beetles were used in each cage, and 200 beetles were used in conducting each test. The spray was applied with a quart-size hand sprayer producing a fine mist. The beetles were subjected to a drenching spray, which was applied from without the cage and forced through the wire cloth on to the beetles. As soon as this was accomplished, the spray nozzle was thrust through the opening of the door of the cage, and the beetles were again sprayed. By this method, both the ventral and the dorsal sides of each beetle were certain to be thoroughly drenched. Unsprayed smartweed plants were used in each cage for food and the percentage of kill of beetles was determined at the end of 24 and 48-hour periods after spraying. Two cages of unsprayed beetles supplied with food were used as checks.

Method of Calculating Results

As a basis for comparison, we have used the per cent kill twenty-four hours after the application of the spray. This was corrected by taking into account the per cent of beetles which died in the checks. For example, if we started with 100 beetles, and found 20 dead in the check, 80 was used as a base in calculating results in the test with soap. If, in this test there were 30 dead out of a total of 100, the treatment with soap was considered to have killed 30–20, or 10 of the 80. This would give $\frac{10}{80} \times 100 = 12.5$ per cent.

In general, if C = per cent dead in checks,

T = per cent dead in test,

and K = corrected per cent kill

$$K = \frac{(T-C) \times 100}{100-C}.$$

The table gives the results of the tests made with solutions corresponding to 4 pounds of soap in 50 gallons of water.

Results

The results show a rather surprising variation in the per cent kill caused by the various soaps. Although the conditions under which the tests were made were kept as nearly constant as possible, there were appreciable variations in temperature and humidity, factors which seem to play an important part in determining the kill. In view of this circumstance, the attempt to correlate the insecticidal properties with the physical and chemical properties of the soaps will be deferred until additional data have been collected during the next beetle season.

PER CENT BEETLES DEAD TWENTY-FOUR HOURS AFTER SPRAYING

Sodium Soaps Oil or fat	No. of Tests	Per cent dead	Potassium Soaps Oil or fat	No. of Tests	Per cent dead
Cocoanut oil	15	85	Palm oil	10	70
Palm oil	10	73	Beef tallow	8	68
Cottonseed oil	13	64	Cocoanut oil	10	65
Menhadin oil	6	64	Mutton tallow	8	63
Sodium oleate	41	59	Cocoa butter	8	55
Beef tallow	6	56	Lard	8	54
Linseed oil	6	56	Cottonseed oil	8	53
Mutton tallow	6	53	Soy bean oil	8	51
Corn oil	6	52	Corn oil	8	50
Neatsfoot oil	8	52	Neatsfoot oil	8	48
Tung oil	6	50	Tung oil	8	45
Lard	6	42	Potassium oleate	25	41
Olive oil	6	38	Menhadin oil	2	38
Cocoa butter	6	32	Olive oil	6	32
Soy bean oil	4	27	Linseed oil	6	25
Cod liver oil	4	11	Japan wax	4	8
Japan wax	2	11	Castor oil	4	4
Castor oil	4	8	Rape oil	4	3
Whale oil	4	3	Whale oil	4	2
Rape oil	4	1	Cod liver oil	4	2

COMPATIBILITIES OF INSECTICIDES. I. FLUOSILICATES AND CRYOLITE WITH ARSENATES

By R. H. CARTER, *Insecticide Division, Bureau of Chemistry and Soils, Washington, D. C.*

A consideration of new combinations of compounds for insecticidal use suggested the possibility of using mixtures of arsenates and fluosilicates, or cryolite, for such purposes, as each class of compounds has well recognized insecticidal value. The use of such combinations might result in increased control of insect pests as well as in a decrease of the objectionable arsenical residue on fruits and other material for human consumption. The fluosilicates in solution have an acid reaction and in general are much more soluble than the arsenates used in insect control. In view of this, an investigation was undertaken to determine the result of mixing these compounds in water as is done in spraying practice.

Smith and Kerr[1] mixed equal amounts of sodium silicofluoride with lead arsenate, calcium arsenate, and Paris green in distilled water for 1-hour periods. They report soluble arsenic (calculated as arsenic

[1]Toxicity of Sodium Silicofluoride and Arsenical Mixtures to Plant Foliage, Offic. Rec. U. S. Dept. of Agr. IV, No. 48, p. 5, 1925.

pentoxide) in percentages of the total amounts of arsenic present as 1.5 per cent, 87.8 to 93.8 per cent, and 9.4 per cent, respectively. With 1 part of Paris green to 19 parts of sodium silicofluoride, 52.2 per cent of the total arsenic was in solution.

The fluorine compounds and arsenates were mixed in the ratio of 2 grams of each to 800 c.c. of tap water (1 pound of each to 45.8 gallons of water), and the mixtures were mechanically agitated for one-half hour. They were then allowed to stand 24 hours at room temperature (approximately 20° C.) when samples of the solutions were taken for analyses.

As severe injury to vegetation may be caused by excessive amounts of soluble arsenic or by solutions having an acid reaction, the solutions were analyzed for these factors.

Soluble arsenic was determined according to standard procedure by reduction to the arsenious form by potassium iodide in sulphuric acid solution and titration with standard iodine solution, starch indicator being used. Results are given in Table 2, calculated to grams arsenic pentoxide per 100 c.c., and in Table 3, calculated to the percentage of the original arsenate which had reacted or gone into solution.

Acidity of the solutions was determined by titration with standard alkali and boiling, phenolphthalein being used as indicator. Results in cubic centimeters of tenth normal sodium hydroxide are shown in Table 4, and in Table 5 are calculated to grams of the respective fluosilicate. Commercial materials were used, with the exception of potassium and barium fluosilicates, which were laboratory preparations. Table 1 shows the significant analyses.

The arsenates were analyzed by determining total arsenic according to the official A.O.A.C. method of distillation with hydrazine sulphate and titration of the arsenious acid with standard iodine solution. The fluosilicates were analyzed by titration with standard alkali, and boiling, phenolphthalein being used as indicator. Six of the more common arsenates and six of the more common and least soluble commercial fluorine insecticides were used.

TABLE 1. SIGNIFICANT ANALYSIS OF ARSENATES AND FLUORINE COMPOUNDS

Arsenates	*Arsenic pentoxide* Per cent
Lead	31.46
Calcium	42.17
Manganese	40.00
Magnesium	40.00
Aluminum	36.8
Barium	25.5

TABLE 1 CONTINUED

Flucrine compounds	*Fluosilicate* Per cent
Sodium fluosilicate	98.0
Potassium fluosilicate	97.7
Barium fluosilicate	70.6
Calcium fluosilicate	43.8
Calcium fluosilicate compound	8.6
Cryolite (synthetic)	98.0 (purity)

The results obtained are given in the following tables:

Table 2 shows the amount of arsenic pentoxide per 100 c.c. of solution which was formed by each of the fluorine compounds during the 24-hour period.

TABLE 2. SOLUBLE ARSENIC AS ARSENIC PENTOXIDE IN GRAMS PER 100 C.C. OF SOLUTION

Arsenate	Sodium fluosilicate Grams	Potassium fluosilicate Grams	Barium fluosilicate Grams	Calcium fluosilicate Grams	Calcium fluosilicate compound Grams	Cryolite Grams	Tap water only Grams
Lead	.0011	.0008	.0008	.0016	.0007	.0007	.0014
Calcium	.0952	.0961	.0815	.0935	.0017	.0006	.0043
Manganese	.0452	.0404	.0310	.0404	.0024	.0005	.0018
Magnesium	.0515	.0134	.0019	.0419	.0002	.0003	.0004
Aluminum	.081	.051	.005	.049	.002	.003	.0077
Barium	.059	.056	.026	.058	.0007	.0004	.0004

The percentage of the original arsenate which had reacted or gone into solution is shown in Table 3.

TABLE 3. PERCENTAGE OF TOTAL ARSENATE DECOMPOSED IN 24 HOURS

Arsenate	Sodium fluosilicate Per cent	Potassium fluosilicate Per cent	Barium fluosilicate Per cent	Calcium fluosilicate Per cent	Calcium fluosilicate compound Per cent	Cryolite Per cent	Tap water only Per cent
Lead	1.4	1.0	1.0	2.0	0.9	0.9	1.7
Calcium	90.3	91.1	77.2	88.7	1.6	0.5	4.0
Manganese	45.2	40.4	31.0	40.4	2.4	0.5	1.8
Magnesium	51.5	13.4	1.9	41.9	0.2	0.3	0.4
Aluminum	88.0	55.4	0.7	53.2	2.1	3.2	8.3
Barium	92.5	87.7	40.8	90.9	1.1	0.6	0.6

When mixed with the fluosilicates, lead arsenate is stable and only relatively small amounts of soluble arsenic were formed in all the mix-

tures used. With lead arsenate there seemed to be a tendency for the fluorine compounds to form less soluble arsenic than is formed in tap water alone. This did not hold true with the fluosilicates of sodium, potassium, barium, and calcium, and the other arsenates, which were largely decomposed. Aluminum and magnesium arsenates with barium fluosilicate formed smaller amounts of soluble arsenic than the other mixtures, except those with lead arsenate.

The presence of cryolite decreased slightly the amount of soluble arsenic formed by all the arsenates used in these experiments, and a crude "calcium fluosilicate compound" containing 8.6 per cent calcium fluosilicate did not materially affect the soluble arsenic content.

It was also noticed that barium fluosilicate caused the formation of smaller amounts of soluble arsenic than the fluosilicates of sodium, potassium, and calcium. This was probably due to its lower solubility. The percentages of soluble arsenic present in mixtures of sodium fluosilicate with lead and calcium arsenates agreed closely with results of Smith and Kerr.[2]

Table 4 shows the cubic centimeters of tenth normal sodium hydroxide required to neutralize 100 c.c. of each of the solutions, with phenolphthalein as indicator.

TABLE 4. CUBIC CENTIMETERS OF 0.10 N SODIUM HYDROXIDE REQUIRED TO NEUTRALIZE 100 C.C OF SOLUTION

Arsenate	Sodium fluosilicate c.c.	Potassium fluosilicate c.c.	Barium fluosilicate c.c.	Calcium fluosilicate c.c.	Calcium fluosilicate compound c.c.	Cryolite c.c.
Lead	50.4	21.5	4.5	27.7	1.1	4.8
Calcium	31.7	15.6	7.7	10.0	alkaline	alkaline
Manganese	40.4	14.8	7.1	17.5	0.0	0.8
Magnesium	18.6	5.4	2.5	3.8	0.0	1.1
Aluminum	46.1	29.2	4.4	30.7	0.2	2.4
Barium	18.9	15.2	5.7	12.6	0.0	0.0

In Table 5 are shown the corresponding weights of the various fluosilicates calculated for comparison.

While this calculation may be slightly in error due to other acid ions and the distribution of the fluosilicate radical between the different bases, it does give a true value of the titratable acid content of the solutions. Cryolite and "calcium fluosilicate compound" had low acidity with all the arsenates tested as they also had low soluble arsenic content.

[2] loc. cit.

Mixtures of magnesium arsenate with the fluosilicates had an acid content consistently lower than that of the other arsenates. The presence of free basic material as magnesium or calcium oxide or hydroxide causes this low acid content by neutralizing part of the fluosilicate.

TABLE 5. GRAMS OF FLUOSILICATE PER 100 C.C OF SOLUTION

Arsenate	Sodium fluosilicate Grams	Potassium fluosilicate Grams	Barium fluosilicate Grams	Calcium fluosilicate Grams	Calcium fluosilicate compound Grams
Lead.....	0.237	0.118	0.031	0.126	0.005
Calcium.....	0.149	0.086	0.054	0.045	None
Manganese....	0.190	0.081	0.049	0.080	None
Magnesium...	0.087	0.029	0.017	0.017	None
Aluminum....	0.2180	0.167	0.031	0.139	0.009
Barium.....	0.089	0.084	0.039	0.057	None

CONCLUSIONS

Tests to determine the compatabilities of arsenates with fluosilicates and cryolite were made by mixing the materials in the ratio of 1 pound each to about 46 gallons of water, mechanically shaking for one-half hour, allowing to stand 24 hours at 20° C., and analyzing portions of the solutions for soluble arsenic and acidity.

Lead arsenate may be mixed in water with the fluosilicates of sodium, potassium, barium, and calcium, without the formation of excessive amounts of soluble arsenic.

With the exception of the "calcium fluosilicate compound," which contained a relatively small percentage of calcium fluosilicate, the five other arsenates, namely, calcium, manganese, magnesium, aluminum, and barium, were largely decomposed by the presence of fluosilicate.

Magnesium and aluminum arsenates were very slightly affected, but calcium, manganese, and barium arsenates were greatly decomposed when mixed with barium fluosilicate in water.

The presence of cryolite seemed to inhibit the formation of soluble arsenic with all the arsenates used.

None of the arsenates developed excessive amounts of soluble arsenic on standing in tap water for 24 hours.

A NEW METHOD OF CONTROLLING FEATHER MITES[1]

By Loyal F. Payne

The dreaded feather mite (*Liponyssus* sp.) described by Cleveland[2] has appeared in the vicinity of Manhattan, Kansas, periodically, since 1919. Lard and vaseline when applied to the infested regions of small chicks proved effective as a remedy. Flowers of sulphur when applied as a dust on adult birds did not result in a complete control but was effective in checking the multiplication and spread of the mites.

The dip treatment consisting of:

Warm water ..... 1 gallon
Soap ..... 1 ounce
Flowers of sulphur ..... 2 ounces

as recommended by the Bureau of Entomology, United States Department of Agriculture has on different occasions effected a complete eradication for the time being.

This method, however, can be used only in warm weather and it, like the sulphur and lard treatment requires the handling of each bird.

Since nicotine sulphate (Black Leaf 40) had proved effective in controlling lice on chickens, the writer decided to test this product on the feather mite. A number of preliminary tests were made where pure Black Leaf 40 was painted three different times at intervals of a few days onto the roosting poles and supports about 20 minutes before the roosts were occupied by the chickens. Living mites could not be found on succeeding examinations.

A final test was made by placing 13 White Leghorn cocks which were heavily infested with feather mites in a house with an adjoining small yard. The roosts occupied by these birds were first painted with Black Leaf 40 on the evening of May 3, 1929. They were again painted on the evenings of the 6th and 9th. The cocks were then examined for living feather mites but none could be found. A second thorough examination of each cock June 5 resulted in the failure to find a live mite. One male which escaped when the others were confined to the house was still heavily infested with mites the first of June. The interior of the house was not cleaned or sprayed during this period.

Since Cleveland reported an incubation period of the eggs from 36 to 96 hours and a complete life cycle from egg to adult in from eight to

[1]Contribution No. 49 from the Department of Poultry Husbandry, Kansas Agricultural Experiment Station.

[2]Cleveland, C. R., Department of Entomology, Purdue University, Agricultural Experiment Station. A New Parasite Threatens the Poultry Industry. Poultry Science, Vol. 11, No. 4, April-May, 1923.

twelve days, we feel that sufficient time was allowed for live mites to appear either from the eggs or from crevices in the building providing any had remained alive.

While it is realized that this is a very limited and preliminary test, the positive results are sufficiently encouraging to pave the way to more extensive studies at some future time.

Black Leaf 40 can be used at any season of the year and it can be applied without handling or disturbing the individual birds. It can be administered with a paint brush or by pouring a small stream from an oil can onto the upper surface of the roosting poles.

HENRI LOUIS DUHAMEL DU MONCEAU: A PIONEER ECONOMIC ENTOMOLOGIST

By PEREZ SIMMONS, *Stored Product Insect Investigations, Bureau of Entomology*

The purpose of this brief communication is to introduce to the members of the American Association of Economic Entomologists one of the earliest workers in our profession. Henri Louis Duhamel du Monceau, whose portrait is published herewith through the courtesy of the Academy of Sciences of France, deserves to be included among those who blazed the trails in economic entomology by reason of having completed an important investigation in insect biology and control, notably well done.

In May, 1761, under the auspices of the Royal Academy of Sciences, and accompanied by an assistant, Mathieu Tillet, Duhamel du Monceau went to Western France to investigate a severe outbreak of a grain moth, now known as the Angoumois grain moth (*Sitotroga cerealella* Olivier), and to devise remedial measures. A survey of conditions was first made, and the approximate limits of the insect's depredations were determined. Cooperative relations were established with a number of interested wheat growers, whose observations and experiments contributed materially to the investigation. Headquarters and a laboratory were established in the old province of Angoumois, at the home of one of the cooperators.

Many facts about the life history of the insect were painstakingly worked out, in the laboratory, in granaries, and in the field. Until very recent years these facts have been the principal source used by those who have published information on the moth.

Experiments in the control of the insect received much attention. Prompt threshing and exposure to high temperatures, followed by storage in bulk, were urged. The importance of protecting areas out-

Plate 25

Henri Louis Duhamel Sgr. du Monceau

side the infested region by a quarantine applying to all unheated wheat was stressed. It was recognized that recommendations alone would not effect a thorough clean-up. Some police power would have to be used:

> "Since it cannot be hoped that our persuasions can engage all the inhabitants to help to the general welfare without reserve, it is here a case where it is necessary for the police to occupy itself to punish all lazy or stubborn people who, by neglecting the operations necessary to preserve their own property, occasion thereby the ruin of their neighbors'."

Entomologists of 1929 can well appreciate the obstacles encountered by Duhamel du Monceau in 1761. In addition to some "lazy or stubborn people," he had to combat a widespread belief in spontaneous generation; and, doubtless, a degree of general unenlightenment that would discourage most modern workers in insect control.

The report on the investigation, one of the first monographic contributions to the literature of economic entomology, was published in Paris in 1762 as a leather-bound volume of 314 pages, illustrated by three plates of excellent drawings, two of them by Duhamel du Monceau. The title is "Histoire d'un insecte qui devore les grains de l'Angoumois; avec les moyens que l'on peut employer pour le détruire." The writer is indebted to his wife, Elisabeth Demet Simmons, for a complete translation, a copy of which is filed in manuscript form in the library of the Bureau of Entomology.

Scientific Notes

Sterility in the San Jose Scale. In 1923, the senior writer made several examinations of San Jose scale in a pear orchard that had been heavily sprayed about May 1 with lime-sulphur. On June 19, about a third of the scales were still alive, but many of them had been unable to extend their winter covering, and their yellow bodies were protruding. When examined July 13, many living females, apparently adult, were found, but no young, although crawlers had been noted in the neighborhood for about four weeks; nor were there any young in the bodies of these females. On August 4, practically the same condition still existed. Most of the trees were almost entirely free of young, but living females were still to be found. The very few young present had probably migrated or been blown from other trees, as there was no sign of embryos in the bodies of the females. At this time, males of the summer brood were nearly mature in other orchards.

Frequent examinations of scales were made by the junior writer in 1925, from late May until the middle of September. On unsprayed trees, young were being produced in some numbers by June 6, and adult males of the summer brood were present by July 17. However, on pear trees sprayed thoroughly with lime-sulphur on March 25, adult females of the winter brood persisted until fall without producing any young. Many of them died during July and August, but on September 16, when the last examination was made, a few were still apparently alive. The same condition was

noted in 1926 and 1927 on apple trees sprayed late in March, some adult females remaining alive until September.

These observations may explain the success of lime-sulphur in controlling the San Jose scale in spite of the fact that actual examinations of the insects a month or so after spraying rarely show a complete mortality. This note is published at this time merely to record the fact that lime-sulphur may in some manner render female San Jose scales sterile. It is evident from these observations that this is a regular occurrence, and not due to some idiosyncrasy of the season, or to the time of spraying or variety of fruit. The writers have not been able to investigate carefully this very interesting phenomenon, but it is their intention to do so at the first opportunity, in order to try to find the cause of this sterility.

E. J. NEWCOMER and M. A. YOTHERS,
Bureau of Entomology, Yakima, Wash.

The Storage of Liquid Lime Sulfur in Steel Drums.—In late years insecticide manufacturers have more and more adopted the practice of shipping liquid lime sulfur in steel drums. As a result, the concentrated lime-sulfur solution remains in contact with an iron container for from several weeks to several months, and occasionally for about a year before being used. It has been found that a slow reaction takes place, resulting in the production of ferrous sulfide and in a slight lowering of the Baumé density due to the removal of sulfur from solution. The precipitated ferrous sulfide is finely divided and remains in suspension for considerable periods, giving the lime sulfur solution a dark-brown color. The only injurious effect upon the lime sulfur consists in the removal of small quantities of sulfur from solution, thus reducing the quantity available as an insecticide. The quantity removed, however, is apparently slight, the Baumé density being reduced only 0.2° during four months' storage and 0.6° during one year.

H. S. SWINGLE, *U. S. Peach Insect Laboratory, Fort Valley, Georgia*

Sulfur a Repellent to *Trichogramma minutum*.—In the artificial rearing of the grain moth, *Sitotroga cerealella*, in large numbers to obtain eggs for food for the egg parasite, *Trichogramma minutum*, it is necessary to have an incubator with fairly uniform temperature and humidity. Such an incubator results in a high production of moths from the corn but also makes it very favorable for the development of obnoxious pests, particularly mites. In the process of breeding moths, our incubators became infested with a Gamasid mite which fed on the grain moths and their eggs. These mites became so numerous that the corn in the breeding rooms was dusted with sulfur. Three light applications of sulfur resulted in almost complete elimination of the mites and caused no ill effect on the moths. This appeared to be very satisfactory until the grain moth eggs were exposed to the parasites, when it was found that almost no eggs were parasitized and that the *T. minutum* adults appeared very sluggish and died in about 24 hours. After eliminating every possible factor, it became apparent that the failure to get multiplication of the parasite was due to the repellent effect of the sulfur. The sulfur rooms were therefore abandoned and the work started again with clean corn in sulfur free rooms and there are now being produced parasites on a large scale. This note is written in the hope that the experience of the experiment station here will warn others now in this work or contemplating starting such work, not to use sulfur in the breeding rooms as a control for mites.

CHARLES H. ALDEN, *Georgia State Board of Entomology, Cornelia, Georgia*

Geraniol Bait as a Possible Attractant for Cicadadae.—Last summer while making collections of Japanese beetles from Geraniol bait traps located in a badly infested apple orchard at Moorestown, N. J., as a part of the State and Government Japanese beetle project, I had occasion to note a number of times that the common dog day Cicada appeared to be attracted to the traps by the Geraniol bait, the bait being prepared in accordance with the recommendations given by the Japanese Beetle Laboratory. About 25 Cicadas were thus caught. Unfortunately, no record of the exact number trapped was kept, and no specimens were saved for species identification. Quite a few Cicadas were present in the orchard throughout the days of August.

The information may induce others to study the value of this bait or its components against the 17 year Cicada in regions where that insect may be prevalent next year or later, and it may have a future economic importance.

NATHANIEL TISCHLER, *Bristol, Pennsylvania*

Insect Nutrition and Metabolism.—In the June issue of the JOURNAL OF ECONOMIC ENTOMOLOGY there appeared a short notice of the publication of an important paper by Mr. B. P. Uvarov of the Imperial Bureau of Entomology on "Insect Nutrition and Metabolism, A Summary of the Literature." In the introduction to this paper it was stated that the more complete abstracts of the several papers consulted by Mr. Uvarov in the preparation of his work were being filed in the Reid Library of the Rowett Research Institute for Animal Nutrition, Aberdeen, and in the Science Library, South Kensington, London. Any American worker who saw that statement must have regretted the fact that at that time no provision had been made for easy access to these fuller abstracts on this side of the Atlantic, and in writing the Secretary of the Committee on Civil Research, I expressed this personal regret, at the same time stating that if perchance an additional copy of these original abstracts were available, Cornell University would be delighted to act as their custodian. It is a great pleasure to announce to American workers on insect nutrition that a complete set of these original abstracts has now been received as a gracious gift from the British Committee on Civil Research and that they are on file in the Cornell University Library. They will within a short time be available under suitable precautions for their safe return through the Library Exchange.

Cornell University not only deeply appreciates this gift from the British Committee but recognizes its obligation to make this assistance available to other American workers. It is of course impossible to send these abstracts to individuals and application for them must be made through some public or university library, which will guarantee their safe return.

E. F. PHILLIPS

Notes on Experiments on Ovipositional Chemotropism.—In a previous note ("A Suggestion for a Possible Application of Ovipositional Chemotropism," JOUR. ECON. ENT., Dec., 1928) the writer indicated that the place of oviposition can be influenced by the presence of a chemical. The insect and the chemical used were not mentioned "since to do so would in no way influence the general principle discussed and might give the erroneous impression that the chemical used was being recommended for the control of the insect in question." The writer is no longer engaged on this problem and, in view of the interest expressed by several investigators, is presenting his data at this time.

The presence of garlic on a golf course fairway, the turf of which had been destroyed by larvae of the Japanese beetle (*Popillia japonica* Newm.), suggested the possibility that allyl sulfide (which has a garlic-like odor) might attract the adult beetles to oviposit in the vicinity. Accordingly, 50 adults of each sex of this species were confined in a cage placed over a flat box of uninfested sod. In one corner of the box was placed a small cup containing allyl sulfide. The material was evidently too strong, as no eggs were found near it.

In the next experiment a solution of two per cent allyl sulfide in grain alcohol was used. A cup containing alcohol alone was placed in another corner of the box. An examination at the end of six days showed an abundance of eggs near the allyl sulfide solution and practically none near the alcohol. In a subsequent experiment similar results were obtained with one per cent allyl sulfide.

This material was the only one tested, and it was tested only on a small scale. If the same response to allyl sulfide, or to any other chemical, should occur under field conditions, it would be of decided value, especially when used in conjunction with poisoned soil. The ease of control by attracting an insect to lay its eggs in a poisoned grass plot is apparent.

J. WILLIAM LIPP, *U. S. Research Laboratories, Moorestown, N. J.*

Relative Covering Power of Miscible Oil and Oil Emulsion.—In view of the claims made by certain manufacturers as to the covering power of commercial miscible oils it has been thought advisable to conduct a series of tests in which comparisons were made with the standard Government-formula soap-oil emulsion.

A commercial miscible oil which will, in the diluted form, according to the manufacturer, "spray two to two and one-half times as many trees with equal thoroness" as will diluted emulsion, was selected for comparison with a commercially manufactured Government-formula oil emulsion.

The most uniform trees in this section were selected for these tests. The same size discs were used thruout. The material was applied at a pressure of 190 pounds.

In Trial No. 1, the actual spraying was done by two farm hands under the supervision of the owner of the orchard and of the writers. These men were very good spray hands and did excellent work.

In Trial No. 2, one of the writers did the actual spraying.

In Trial No. 3, the actual spraying was done by a negro who is one of the best spray hands in this section.

The results of these tests were as follows:

Trial No.	Material used‡	Number of gallons applied	Number of trees covered
1	Commercial miscible oil	200	240
	Government-formula oil emulsion	200	255
2*	Commercial miscible oil	25	21
	Government-formula oil emulsion	25	20
3*	Commercial miscible oil	25	18
	Government-formula oil emulsion	25	17

*Trees in these plats were considerably larger than those in plat 1.

‡The duluted miscible oil spray contained 5% of oil by volume, whereas the oil-emulsion spray contained 3% of oil. These are the strengths ordinarily recommended.

OLIVER I. SNAPP and H. S. SWINGLE,
U. S. Peach Insect Laboratory, Fort Valley, Georgia

COMMON NAMES OF INSECTS APPROVED FOR GENERAL USE BY AMERICAN ECONOMIC ENTOMOLOGISTS

FOURTH SUPPLEMENT TO LIST APPEARING IN VOLUME 19, PAGES 788–9

The following list of common names was submitted to the active members of the Association for their approval, with the understanding that five votes cast against any name would prevent its adoption. The number following each name indicates the votes against that name:

Laspeyresia molesta Busck	Oriental fruit moth	48
	Oriental fruit worm	94
	Oriental peach moth	100
	Oriental peach worm	111
Rhagoletis juglandis Cress	Walnut fly	10
Barathra configurata Walk	Bertha armyworm	8
Serica (Autoserica) castanea Arrow	Oriental garden beetle	9
Anomala orientalis Waterh	Asiatic beetle	1
Eusimulium pecuarum Riley	Buffalo gnat	6
Phytonomus nigrirostris Fab	Clover budworm	62
	Lesser clover leaf weevil	24
Aphis spiraecola Patch	Citrus aphid	14
Paratetranychus pilosus C. & F	European red mite	0
Tetranychus telarius L	Cotton red spider	109
	Greenhouse red spider	92
	Red spider mite	77
	Two-spotted mite	98
Pseudococcus gahani Green	Citrophilus mealybug	3
Ellopia fiscellaria Guen	Hemlock looper	5
Chrysobothris mali Horn	Pacific flat-headed borer	5

It will be seen from this vote that but three of the names submitted to the Association were adopted.

Anomala orientalis Waterh	Asiatic beetle
Paratetranychus pilosus C. & F	European red mite
Pseudococcus gahani Green	Citrophilus mealybug

Some of the other insects on this list must of necessity have approved common names, and the Committee wishes members of the Association to carefully consider the vote cast upon these names in order that a concensus of opinion may be reached at the next annual meeting.

THE ROCKY MOUNTAIN CONFERENCE OF ENTOMOLOGISTS

The sixth annual meeting of The Rocky Mountain Conference of Entomologists was held in the Colorado Agricultural College Forestry Lodge, Pingree Park, Colorado, August 19 to 24 inclusive.

The schedule of meetings was arranged by the program committee which was selected at the first meeting. This committee consisted of Geo. A. Dean, F. B. Paddock and Geo. M. List. Ten sessions for papers and discussions were held, with the following topics for consideration:

The Bee Moth—F. B. Paddock
Grasshopper Investigations—R. L. Shotwell
The Alfalfa Weevil in Colorado—J. H. Newton
The Spruce Gall Aphid—C. P. Gillette
Aphids on Conifers of Colorado—Miss M. A. Palmer
Fumigating Gases—George A. Dean
The Clover Root Curculio on Alfalfa in Kansas—Donald A. Wilbur
Some Relations between Leaf and Fruit Growth of Two Varieties of Apples and the Quantity of Lead Arsenate Maintained—C. C. Hamilton
Codling Moth Traps—J. H. Newton

Codling Moth Work at the Wichita, Kansas Station—H. G. Butler
The Mormon Cricket Control Campaign in Colorado—F. T. Cowan
Some Ideas on the Control of the American Foul Brood—R. G. Richmond
Breeding *Trichogramma minutum*—Geo. M. List
Oils—J. G. Sanders
The Effect of Insects upon Civilization—George A. Dean
Symposium—Teaching Entomology
General Discussion and Summary—C. P. Gillette
General Courses—K. C. Sullivan
Graduate Teaching—D. A. Wilbur
Laboratory Teaching—C. R. Jones
The View Point of a Commercial Entomologist—J. G. Sanders
The View Point of a Producer—E. R. Bliss
The View Point of a Field Entomologist—J. H. Newton
Plant Inspection in Nebraska—L. M. Gates
Aquatic Insects of the Ozarks—K. C. Sullivan
Insect Egg Penetration—L. B. Daniels
The Mediterranean Fruit Fly—Geo. A. Dean

The informal nature of the meetings led to a free and open discussion of all subjects listed and many others not recorded in this brief report. Even with the appeal of fishing, collecting, and games at hand, most sessions ran over the alloted time. The symposium on teaching especially was a free for all. This particular session was started at 8:30 in the morning and with only an hour out for lunch continued until 3 p.m. The various opinions as to methods of teaching and shortcomings of the work led to the passing unanimously of the following recommendations:

Resolved, That the Conference recommend to our respective institutions and others concerned that:

1. Every student in agriculture be given a course in entomology and that this be given not later than the sophomore year.
2. That a course in entomology be required for all those taking up county extension agent work and vocational agriculture teaching.
3. That where an entomology department exists in an institution it be given charge of all entomological work of the institution.
4. That more attention be given to entomology in boys and girls club work.
5. That each candidate for a masters degree in entomology be required to have at least one-half year in insect morphology and one-half year in insect taxonomy.

The Kansas Entomological Society invited the Rocky Mountain Conference to have a summary of all papers presented and lists of insects collected in Pingree Park, published in the *Kansas Entomologist*. The Conference Secretary was requested to take the matter up in detail with the editorial staff of this publication.

A total of 64 entomologists and members of their families registered at camp. Those directly interested in Entomology were R. L. Shotwell, K. C. Sullivan, G. A. Dean, L. Johnson, F. B. Paddock, H. G. Butler, Donald A. Wilbur, Miriam A. Palmer, J. G. Sanders, Frank T. Cowan, C. P. Gillette, Sam C. McCampbell, Geo. M. List, Louis G. Davis, C. C. Hamilton, E. R. Bliss, Carl A. Bjurman, R. G. Richmond, Horace G. Smith, Leo J. Doering, L. M. Gates, L. B. Daniels, Geo.I. Reeves and C. R. Jones.

In addition to the sessions for papers time was taken each day for collecting, trips to points of interest, fishing, horse shoe pitching, and other forms of recreation. Only an evening meeting was held on Thursday, the entire day being given for a horseback trip to Hallets Glacier. In the evening Mr. E. R. Bliss who has spent much time in the mountains of Colorado and Wyoming, told of the Hallets Glacier trip. From Hagues Peak on which the glacier is located five mountain ranges, one as far away as Leadville, Colorado, could be seen. The cities of Laramie and Cheyenne, Wyoming, and Loveland, Fort Collins and Estes Park, Colorado, were visible.

As a result of the persistence of some (C. R. Jones brought in 45 on Thursday) all had at least two good meals of mountain trout. After a hard struggle J. G. Sanders took the horse-shoe pitching championship back to Pennsylvania, but Prof. G. A. Dean proved to the lady judges that he had little competition in the whisker contest.

The old officers were retained for another year. These are C. P. Gillette, Chairman, J. W. McCulloch, Vice-Chairman, Geo. M. List, Secretary and C. R. Jones, Treasurer.

GEORGE M. LIST, *Secretary*

JOURNAL OF ECONOMIC ENTOMOLOGY

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The editors will thankfully receive news matter and other items likely to be of interest to our readers. Papers will be published as far as possible in the order of reception, except that papers of reasonable length may be accepted in the discretion of the editor for early publication at $2.50 per page for all matter in excess of six printed pages, a part page counting as a full page, this limit not including acceptable illustrations. Photo-engravings may be obtained by authors at cost.

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ANNUAL SCIENTIFIC MEETINGS: 1929–30, Des Moines; 1930–31, Cleveland; 1931–32, probably New Orleans; 1932–33, Chicago; 1933–34, undecided; 1934–35, probably Rochester.

The Mediterranean fruit fly, also known as the Medfly, continues to be of great interest. One of the latest and most important developments is the commissioning of Professor H. J. Quayle of the University of California and the Citrus Experiment Station, to make a study of this insect in the Mediterranean basin in particular. This survey has been made possible through the cooperation of Allison V. Armour, of New York, who has provided a vessel specially equipped for biological or other scientific work. The cost of the expedition, except the salary of the research agent, will be defrayed by Mr. Armour, who will accompany Professor Quayle and participate in the work in every possible way. There will be brief studies of the fruit fly situation in the Bermuda Islands and at the Azores en route to the Mediterranean. The winter may be spent in South Africa to cover the fruit harvesting months in that section of the world. The program will conclude with a return to the Mediterranean section in April to complete the seasonal record of the fly in that region during the spring and early summer months. The project is under the direction of the United States Department of Agriculture. The completion of this should result in an outstanding contribution to economic entomology and have a profound effect upon the material prosperity of the country. It is of

more than national importance. It may have a most significant bearing upon the problems of the areas now infested by this pest as well as aid in solving those in America caused by the appearance of this insect. There is a possibility of the pest acquiring permanent residence in this country, although there are many who object. We may be obliged to learn to live with the insect. We must know about it and in the learning expect a practicable way of dealing with the situation will be found. We venture the opinion that more surveys of this character will be undertaken in the future. Many entomological problems are international in scope. It is certain that all acquainted with the Mediterranean fruit fly situation in Florida will endorse most heartily this contribution by Mr. Armour. It is on a parity with many other projects for the promotion of the general welfare of humanity.

Reviews

Laboratory and Field Ecology, The Responses of Animals as Indicators of Correct Working Methods by VICTOR E. SHELFORD, pages i–xii, 1–608, 216 text illustrations, The Williams & Wilkins Company, Baltimore, 1929.

Economic entomology deals with so many phases of life that the student of injurious insects must of necessity be an ecologist. The investigator of insect habits and reactions will find much of value in this work, summarizing as it does, many of the factors affecting vital activities. There are chapters on Ecology and Climatology, Biotic Observation and Experimentation, Behavior and Acclimation, Food and Food Effects, Soil and the Growth of Food Plants, Dormancy and Other Quiescent States, Animals in Relation to Temperature, Control and Measurement of Temperature, Ventilation under Experimental Conditions, Control and Measurement of Moisture, Temperature and Humidity in Combination, The Effect and Measurement of Air Pressure and Evaporation, Light Conditions and Effects, Measurement and Control of Light, Evaluation of Other Factors than Temperature and Moisture, Location and Planning of Buildings and Equipment, Physical Conditions, Light Conditions and Chemical Conditions in Water. The appendix discusses Records, Equipment for Keeping Animals Alive, Estimated Cost of Materials and Equipment and Sources of Equipment. Throughout the volume may be found references to over a thousand well selected citations, thus making it easy to locate the sources of information. Entomologists will find many references to insects and should learn much from the data presented in relation to other forms of life. The descriptions of technique and apparatus must appeal strongly to the investigator. There are most valuable suggestions for field and laboratory work. This is a constructive, suggestive volume invaluable for reference.

E. P. F.

Current Notes

Entomologists from Illinois inspected corn borer work in northwestern Ohio during the first week of September.

Miss Hazel Riddle of Moorhead, Minnesota, has been appointed Assistant Entomologist at the North Dakota Agricultural College.

John Hadjinicolaou, a Greek entomological student, visited at the Ohio Station during the early part of September.

F. R. Lawson has been appointed temporary field assistant, Bureau of Entomology, for duty at Salt Lake City, Utah.

On May 18, George R. Bell was appointed Field Assistant, Bureau of Entomology, and assigned to the Dried Fruit Insect Laboratory.

W. J. Phillips, Bureau of Entomology, in charge of the field laboratory at Charlottesville, Va., spent July 27 in the Washington office.

Robert J. Webb has accepted an appointment as Junior Entomologist, Bureau of Entomology, for duty at Monroe, Mich., effective July 31.

On June 17 Lawrence M. Fenwick was appointed Field Assistant and assigned to the field laboratory, Bureau of Entomology, at Sligo, Md.

P. N. Annand has been appointed associate entomologist Bureau of Entomology to undertake studies of the sugar-beet leafhopper at Davis, Calif.

D. L. Van Dine, local director of the Cuba Sugar Club Experiment Station, visited the field laboratory at New Orleans on July 13.

B. E. Montgomery has accepted a position as instructor in Entomology at Purdue University.

G. A. Filinger has been granted a years leave of absence from the Ohio Experiment Station for graduate work at the University of Minnesota.

John A. Rodd of the Liverpool Cotton Service, of Liverpool, England, was a visitor at the Bureau of Entomology field laboratory at Tallulah on July 23.

J. A. G. Rehn, of the Philadelphia Academy of Natural Sciences, visited the Taxonomic Unit Bureau of Entomology, June 13, to confer with A. N. Caudell.

W. A. Shands has been appointed assistant entomologist, Bureau of Entomology, and assigned to work on the sugar-beet leafhopper at Salt Lake City, Utah.

C. O. Hopkins, Extension Entomologist, Baton Rouge, La., visited the Entomology field laboratory at Tallulah on July 16 for conference on boll-weevil conditions in the State.

Professor O. G. Anderson, who spent the summer at the Ohio Agricultural Experiment Station, Wooster, Ohio, working on manganese arsenate, has returned to Purdue University.

C. G. Woodbury, of the National Canners Association, Washington, D. C., visited the Bureau of Entomology, summer Laboratory at Columbus, Wis., during the early part of July.

On June 28, Dr. E. A. Back, Bureau of Entomology, attended the Convention of the Tobacco Association of the United States, which met this year at Hotel Cavalier, Virginia Beach, Va.

On June 26, W. S. Abbott, W. M. Davidson, and D. P, Perry, of the Food, Drug and Insecticide Administration, visited the Japanese-Beetle Laboratory, to consult with members of the staff.

A. C. Hodson, from the University of Minnesota, has been appointed Field Assistant, Bureau of Entomology, and assigned to work on parasites of the oriental peach moth, at Moorestown.

E. G. Kelsheimer, of the Ohio Experiment Station will start graduate work at Ohio State University on October 1. He has been granted a years leave of absence for this purpose.

Professor John Gray, professor of Entomology and Plant Pathology in the University of Florida has spent the past summer in graduate work at Cornell University and will continue throughout the year research work in entomology toward completing requirements for his Doctor's degree.

W. D. Reed, of the Bureau of Entomology Dried Fruit Insect Laboratory at Fresno, Calif., spent May 9 and 22, 1929, at headquarters for consultation, examination of literature and preparation of manuscript.

Miss Marjorie Jones has received an appointment as Under Scientific Helper, Bureau of Entomology to take the place of Mrs. L. H. Richardson, who resigned from her position in June.

B. J. Landis, Bureau of Entomology, arrived at Mexico City on June 13, where he will investigate the biology and host relationships of the parasites of the Mexican bean beetle.

Mr. William Robert Horsfall, who graduated from the University of Arkansas and obtained his Master's degree at Kansas State Agricultural College has entered the Department of Entomology at Cornell University to study for his Ph.D. degree.

Professor G. F. McLeod of Pennsylvania State College is on leave of absence for a year which he is spending at Cornell University to complete his work for his Doctor's degree. He is carrying on investigations on the effect of certain light rays on insects in conjunction with the Departments of Entomology and Physics.

Late in July Dr. H. E. Ewing, Bureau of Entomology, started on another field trip to Virginia and North Carolina, in order to continue his studies on the biology of chiggers.

R. S. Filmer, Junior Entomologist, Bureau of Entomology, who was associated with Dr. Campbell in orchard-insecticide investigations, resigned from the Bureau, effective May 2, to accept a fellowship at Rutgers University.

Dr. C. E. Mickel has been employed by the bureau of Entomology to work for the second summer on the mutillid collections, and was so engaged until about the middle of September.

By transfer from the Biological Survey, L. L. Buchanan has been added to the staff of the Taxonomic Unit, in order to work on Rhynchophora and Adephaga for the Bureau of Entomology.

O. A. Hills, and J. C. Chamberlin, Bureau of Entomology, have been appointed as Junior and Associate Entomologists, respectively, the former to serve at Hermiston, Oreg., and the latter at Palo Alto, Calif.

Mr. C. B. Hutchings, Entomological Branch, is actively engaged in preparing the annual entomological exhibits to be displayed at the Central Canada, and Canadian National Exhibitions held at Ottawa and Toronto, respectively.

Dr. J. McDunnough and Mr. G. S. Walley, Entomological Branch, who are collecting insects in the Knowlton district, Que., spent two weeks in July, at Gorham, New Hampshire, in connection with their faunal studies.

On June 17, Dr. T. E. Snyder, Bureau of Entomology, returned to Washington, D. C. after giving a course in biological entomology in the Department of Biology, University of Chicago, from April 1 to June 12.

Mr. James T. Culbertson, who graduated at William & Mary College and later pursued graduate work at the University of Michigan, has entered Cornell University for advanced study in entomology toward his Doctor's degree.

Temporary appointments in the Bureau of Entomology were given in June to Adam M. Celaya, at Tempe, Ariz., Clyde B. Conger, Sacramento, Calif., James B. Gahan, Webster Groves, Mo., and Richard A. Gaskins, Richmond, Va.

Prof. C. O. Eddy, in charge of research in Entomology at the Clemson College Experiment Station received the degree of Doctor of Philosophy at Ohio State University in August.

A. W. Morrill, Jr., a graduate of the University of California, has been appointed Field Assistant, Bureau of Entomology and assigned to duty at Yakima, Wash., where he is assisting E. J. Newcomer in apple insect investigations.

V. R. Diamond who assisted G. A. Ficht, corn borer investigator of the Purdue University Agricultural Experiment Station, has accepted an assistantship in the Biology Department of Purdue University and has registered for his doctorate in Entomology.

Prof. M. A. Stewart, of Rice Institute, Houston, Tex., spent June 14 and 15 in the National Museum studying certain types of Siphonaptera, as a step in his work of preparing a revision of the North American species.

Prof. W. A. Price, formerly a member of the teaching and experimental staff of the Dept. of Entomology, Purdue University, has recently been appointed State Entomologist of Kentucky where he assumed his new duties September first.

Mr. R. G. Nel of Transvaal University, South Africa, who spent the year 1927–28 at Cornell University in entomological research and the following year with Professor Quayle at Riverside, Calif., in a special study of certain citrus insects has returned to Cornell to finish the work for his Ph.D. degree.

Mrs. Helen Russell, of the Santa Clara, Calif., plant of Libby, McNeill and Libby, spent July 25 to 29 at the Dried Fruit Insect Laboratory of Fresno studying the insects affecting dried fruits, and literature relating to the subject.

Mr. Clarence R. Phipps of Orono, Maine, who has been investigating the insect pests of the blueberry has come to Cornell University on a year's leave of absence to complete his work for the Doctor's degree.

Mr. A. E. Brower, from the Southwest Missouri State Teachers College is entering upon his second year of graduate work in entomology at Cornell University. Mr. Brower is interested in the genus Catocala and is making a monographic study of the biology of this genus. During the past summer he completed a very interesting study of the local migrations of these moths. He has two papers on them in press.

Professor Roy C. Tasker, a graduate of Hillsdale College, Mich., and post graduate of the University of Michigan, has returned from China where he held a professorship in Soochow University, to enter upon his work at Cornell University for his Ph.D. degree. Mr. Tasker is Fellow in entomology.

B. E. Montgomery, who has received his master's degree at Purdue University, has been appointed Field Assistant, Bureau of Entomology, at the field laboratory at Vincennes, Ind., where he is assisting in investigations of deciduous-fruit insects.

W. P. Yetter, Jr., a graduate of the Colorado Agricultural College, was appointed Associate Entomologist, Bureau of Entomology May 9, and assigned to duty at Vincennes, Ind., where he will carry on investigations of the oriental peach moth.

M. C. Lane, Bureau of Entomology, in charge of the field laboratory at Walla Walla, Wash., visited Bozeman, Mont., July 17 to 19, where he conferred with entomologists and other agricultural workers regarding the wireworm problem in the Pacific Northwest.

The following new employees were appointed and reported for duty at the Boll weevil laboratory at Tallulah in July, Harry Gimora, and J. M. Yeates, agents, V. C. Howell, H. R. Johnston, Andrew Spinks and James Watkins, temporary field assistants.

Oliver I. Snapp, Bureau of Entomology, gave an address on control of peach insects before the Rotary Club in Americus, Ga., on May 29. The peach growers of Sumter County, Ga., were guests of the club for the occasion.

On June 17, Dr. Ruth Marshall, Professor of Biology, Rockford College, Rockford, Ill., called at the National Museum to examine types of water mites. She was on her way to Europe, where she spent the summer in study.

On June 11, Yoshio Ouchi, who was J. L. King's assistant while the latter was conducting parasite investigations at Suigen, Korea, in 1922, visited the Japanese-beetle Laboratory. He has been a student at Leland Stanford University for the past two years.

Dr. H. W. Allen, Bureau of Entomology, has been transferred from the Japanese beetle project to peach-insect investigations, and is now in charge of the work on parasites of the oriental peach moth at the field laboratory at Moorestown.

Dr. R. T. Cotton, Bureau of Entomology, left Washington July 5 for a visit to the field laboratories at Modesto and Fresno, Calif. While on the Pacific Coast Dr. Cotton will visit various establishments conducting work of interest to this office.

Dr. S. W. Frost, of Pennsylvania State College, called at the National Museum on July 8 to consult with several specialists of the Bureau of Entomology. He returned recently from a trip to Panama, where he studied various leaf-mining insects.

Mr. F. H. Butt, B. A., and M. A. from the University of Washington, is entering on the second year of research work in entomology at Cornell University for his Doctor's degree.

Mr. L. E. Dills who has a Master's degree from Iowa State College and who has been scouting for the Asiatic and Japanese beetles the past summer, has returned to Cornell University to go on with advanced work toward his Doctor's degree.

Mr. Harold G. Wilm, a graduate of Colorado College who is interested in forest insects, has entered Cornell University to pursue advanced work in forestry and in forest insects with special reference to his Doctor's degree in entomology.

Mr. W. E. Blauvelt, instructor in extension, who spent half a year in graduate work in entomology at Cornell University in 1927–28, is entering again this fall upon a full year of research in entomology for his Doctor's degree.

William Blakiston, a student at George Washington University, was appointed Field Assistant, Bureau of Entomology, July 15, and assigned to duty at the field laboratory at Sligo, Md., where he is assisting Luther Brown in investigations of parasites of the codling moth.

Mr. Sidney Jones, a graduate of Oregon State College, obtained his Master's degree from Ames, Iowa in 1928 and is now a candidate for his advanced degree in entomology at Cornell University.

Fred E. Brooks, Bureau of Entomology, in charge of the field laboratory at French Creek, W. Va., visited a number of chestnut growers in Pennsylvania, Maryland, Delaware, and Virginia, June 5 to 14, gathering data to use in a study of the chestnut curculio.

Mr. F. H. Wilson, Professor of Biology at the University of Richmond, Va., has returned to Cornell University to continue his graduate work in the Department of Entomology.

W. J. Reid, Jr., Chadbourn, N. C., who has been temporarily detailed to Columbus, Ohio, where he assisted D. M. DeLong in the investigation of the potato leafhopper on beans returned to Chadbourn, September 1st to resume work on the seed corn maggot.

A small shipment of adults of *Mesoleius tenthredinis*, a parasite of the larch sawfly, arrived at the Gipsy-Moth Laboratory, Melrose Highlands, Mass., on July 24. These were kindly sent from Canada by A. B. Baird, in charge of the Dominion Parasite Laboratory.

W. E. Stone, Bureau of Entomology, formerly in charge of the celery leaf-tyer investigations at Sanford, Fla., has been temporarily detailed to the Plant Quarantine and control Administration to assist in organizing the scouting for wild hosts of the Mediterranean fruit fly.

W. L. Baker, who assisted L. F. Steiner of the Bedford, Indiana, codling moth laboratory of the Purdue University Agricultural Experiment Station, has resigned to accept a position with the Bureau of Entomology. He will be located at Melrose Highlands.

During the latter part of July, Mr. Arthur Kelsall, Entomological Branch, visited New Brunswick to discuss with Mr. G. P. Walker the investigational work with various insecticides being carried on by the latter and Mr. C. W. Maxwell, in the French Lake District of Canada.

Miss Catherine Ford, a graduate of Iowa State College, has been given an appointment as Junior Entomologist, Taxonomic Division, to continue the work of cataloging taxonomic literature begun by Mrs, Mansuy before the latter was transferred to the Plant Quarantine and Control Administration.

Mr. Franklin Sherman III, who graduated at Clemson College and later obtained his M. S. degree at the Texas Agricultural and Mechanical College and subsequently spent a year at the University of Texas as an instructor in Zoology at the same time carrying on graduate work in zoology, is entering on his second year of graduate work in entomology at Cornell University. He has spent two summers in Western New York working on the biology and control of the striped cucumber beetle.

Mr. Merrill M. Darley of Salt Lake City, Utah, received the degree of Master of Science at Ohio State University in August and has been appointed Junior Entomologist Cereal and Forage Insect Investigations and assigned to the Alfalfa Weevil project at Salt Lake City.

L. G. Baumhofer, Bureau of Entomology, who was stationed at Coeur d'Alene, Idaho, during the winter, has been transferred to Halsey, Nebr., where he is working on the introduction of parasites of the pine tip moth in the pine plantations in the vicinity of that place.

On July 21, Dr. F. C. Craighead, Bureau of Entomology, left for a western trip. He visited the forest-insect field laboratory at Coeur d'Alene, Idaho, and plans to inspect field projects of the Division of Forest Insects in the States of Idaho, Montana, Oregon and California.

In the latter part of July Mr. B. R. Coad, Bureau of Entomology, visited several points in Oklahoma, where experiments in control of the boll weevil are being conducted by the Bureau of Entomology in cooperation with the Oklahoma Agricultural Experiment Station and the Extension Service.

On June 10, Tomosuke Nakashima, Plant Pathologist at the Chosen Agricultural College, Suigen, Korea, visited the Japanese Beetle Laboratory at Moorestown. Mr. Nakashima has been associated with the work of the Department of Agriculture in Korea since 1922. He was particularly interested in the work on parasites.

Dr. Alvah Peterson, Professor of Entomology at Ohio State University, visited the Japanese Beetle Laboratory, Moorestown, N. J., the Gipsy Moth and Corn Borer Laboratories near Boston, the Connecticut Experiment Station, New Jersey Experiment Station, and the Corn Borer Laboratories at Oak Harbor, Ohio, and Monroe Michigan during August to study different methods of handling parasites.

Mr. S. M. K. Hu, a graduate student at Johns Hopkins University, spent the summer in the Department of Entomology of Cornell University. He conducted extensive experiments on the transmission of the dog filaria, *Dirofilaria immitis*, by mosquitoes and secured many records of new intermediate hosts. He also completed his work for the Master's degree.

Since about the middle of May, Harold Lewis, of the California Fruit Growers, exchange, has been at the Bureau of Entomology field laboratory at Lindsay, Calif., familiarizing himself with the problem of the citrus thrips and assisting E. A. McGregor, in charge, in the work on that insect.

Mr. Alan Stone, an Assistant in the Department of Entomology of Cornell University for the past four years, completed his work for the Doctor's degree during the summer. He has recently accepted a position in the Department of Biology at Dartmouth College.

C. W. Collins, Bureau of Entomology, in charge of the Gipsy-Moth laboratory has been in the hospital at Melrose, Mass., since July 16, because of a severe attack of blood poisoning. There has been a gradual improvement in his condition but he is still confined to the hospital.

D. F. Barnes, Bureau of Entomology, of the Gipsy Moth Laboratory, left for Canada on June 23, to spend several days observing experiments in airplane dusting particularly for the spruce bud worm, conducted by the Forest Insects Division, Entomological Branch, Dominion of Canada, at Westree, Ontario, and Franquelin, Quebec.

Professor W. J. Sowder of East Bradford, Va., who received his M. S. from Cornell several years ago is spending the year in the Department of Entomology, Cornell University, in graduate study toward his Doctor's degree.

Mr. A. L. Brodie, who spent the summer at the Gypsy Moth Laboratory, U. S. Bureau of Entomology, has returned to Cornell University to continue his graduate work in the field of insect parasitology.

Mr. M. A. Stewart, Instructor in Medical Entomology and Parasitology at Rice Institute, Houston, Texas, spent the summer in the Department of Entomology at Cornell University. He recently completed his work for the Doctor's degree and has returned to Rice Institute.

Mr. A. G. Richards, Jr., of the class of '29, University of Georgia, is engaged in graduate work for the degree of Doctor of Philosophy in the Department of Entomology at Cornell University.

Mr. E. H. Hinman, a graduate of Queens University, Canada, spent the past two summers doing special work on mosquito Ecology with Professor Matheson. This work was made possible by a grant from the Heckscher Research Foundation of Cornell University.

G. C. McGinley, airplane pilot, stationed at Tallulah, La., arrived in Washington, July 10 to take charge of a De Haviland airplane which had been transferred from the War Department to the Department of Agriculture. He took off in the plane for Tallulah on July 11, arriving there the next day.

Mr. Louis Wolf, a graduate of the University of Wisconsin, and now an Instructor in Biology in Cornell University is completing his work for the degree of Ph.D. in the Department of Entomology at Cornell.

The following college students have been given employment at the Bureau of Entomology Gipsy Moth Laboratory, for the summer season, reporting for duty in June: J. T. Bigham, Ohio State University, J. L. Gardiner, University of Maryland, C. B. Green, Boston University, and S. C. Billings and A. J. Warren, Massachusetts Agricultural College.

Mr. V. S. L. Pate, has returned to Cornell University from the Mt. Desert Laboratory of Biology to resume his graduate studies in the Department of Entomology. He expects to complete his work for the Ph.D. degree this year.

Prof. J. J. Davis, of Purdue University, spent three days early in June at the Japanese Beetle Laboratory at Moorestown, supervising the collection of material containing *Macrocentrus ancylivora*. The parasites obtained were for liberation in the peach-growing sections of Indiana that are heavily infested with the oriental peach moth.

Mr. Wm. R. Horsfall, a graduate assistant in Entomology for the past year at the Kansas State Agricultural College, received his degree of Master of Science last July and was appointed a Fellow in the Department of Entomology at Cornell University where he will pursue graduate work for his doctorate.

William Middleton, Bureau of Entomology, attended a conference at the Northeastern Forest Experiment Station, Amherst, Mass., on June 3, and on June 10 and 11, with Dr. Carl Hartley, of the Division of Forest Pathology, Bureau of Plant Industry, made an examination of some areas of dying pine in Maryland and New Jersey.

Mr. E. B. Watson, Entomological Branch, is continuing a biological study of the hemlock looper at Trinity Bay, about 50 miles below Manacouagan, on the north shore of the St. Lawrence. In this area possibly about 1,000,000 cords of balsam-spruce pulpwood is being destroyed and the situation is evidently very serious.

Mr. Gideon Tingwei Lew, a graduate of Yenching University, Peiping, China, and who is engaged in the study of Chinese dragonflies, is now studying in the Department of Entomology, Cornell University, under the direction of Professor Needham.

Andre Seyrig, of Paris, France, a mining engineer and amateur specialist on Ichneumonidae, spent June 11 discussing these insects with R. A. Cushman at the National Museum. He brought as a gift to Mr. Cushman a collection of about 150 specimens of European Ichneumonidae, including cotypes of three of his own species.

Mr. A. B. Klots, after spending the summer in the Rockies collecting insects has returned to Cornell University to resume his graduate studies in the Department of Entomology.

George B. Wagner, who received the degree of Master of Science in Entomology last June from the Kansas State Agricultural College, was appointed Assistant Entomologist July 13, and has been assigned to investigations of flour-mill insects in the southwestern milling district. Mr. Wagner spent July 22 to 24 in Washington. He is located at Manhattan, Kansas, and is cooperating with the State Agricultural College.

Howard Evarts Weed, formerly engaged in entomological work, and known as the inventor of the "Kero Water" spray pump, which was much used in the early days of the San Jose scale, was a recent caller at the Bureau of Entomology, Washington, D. C. He is now engaged in landscape work in Portland, Oreg.

Mr. S. A. Summerland, a graduate student in Entomology for the past year at the Kansas State Agricultural College, received his degree of Master of Science last July and was appointed Junior Entomologist in the United States Bureau of Entomology. He is located at Bentonville, Arkansas, where he is assisting with the Codling Moth Investigations.

About the middle of June, Prof. Chas. J. Sorenson, of the Utah Agricultural College, at Logan, visited the Bureau of Entomology field laboratory at Tempe, Ariz., and conferred with the men there regarding investigations of the clover and alfalfa seed chalcis fly which are being carried on in cooperation with the State of Utah.

Dr. A. L. Quaintance, Bureau of Entomology, recently visited the field Laboratory at Moorestown, N. J., and went over the work there under way in some detail with L. B. Smith, in charge. A visit to Westbury, Long Island, was made to observe the investigations on the Asiatic beetle being conducted there by H. C. Hallock and his assistants.

Dr. George S. Langford, who received his degree at Ohio State University in June, has been appointed as Associate Entomologist at the University of Maryland and assumed his duties on the 15th of June. Dr. Langford will have charge of the Japanese beetle and European corn borer work and other phases of the regulatory work in Maryland.

In the latter part of June, B. R. Coad, Bureau of Entomology, and Messrs. McGinley, Payne, and Long took two airplanes to Dallas, Tex., at the request of the Division of Agricultural Engineering of the Department of Agriculture, to show methods of airplane dusting to the agricultural engineers then attending the annual meeting of the American Association of Agricultural Engineers.

Dr. A. C. Baker, Bureau of Entomology, returned June 24 to his temporary headquarters at Orlando, Fla., after spending a week in Washington. While at Washington he conferred with various persons in the Bureau of Entomology and the Plant Quarantine and Control Administration on the research work on the Mediterranean fruit fly which he is now conducting in Florida.

Mr. E. R. Buckell, Entomological Branch, attended the twelfth annual meeting of the Northwest Association of Horticulturists, Entomologists and Plant Pathologists, held at Montana State College, Bozeman, July 17–19. Messrs. W. Downes and Eric Hearle of the Victoria and Kamloops laboratories also attended the meeting and papers were presented by the above three officers and by Mr. Venables.

R. E. Balch, a field assistant, Bureau of Entomology, who has been with the Forest Insect division the last two summers, reported for duty early in June and was assigned for that month to the experiments in airplane dusting which are being conducted by Dr. J. M. Swaine in Ontario, Canada. At the completion of this work Mr. Balch will report in Montana, where he will study problems of defoliation.

At the Eastern Nurserymen's Association meeting at Milford, Delaware, the following entomologists and regulatory officials were guests: R. H. Bell, F. M. Trimble of Pennsylvania; T. J. Headlee, L. B. Smith, and C. H. Hadley of New Jersey; Senator Newton, J. F. Adams, and R. A. Wilson of Delaware; E. N. Cory and G. S. Langford of Maryland. Brief addresses were made by several of the group.

Prof. J. W. Bailey, of Mississippi A. and M. College, at Clinton, with his senior class in entomology, composed of 26 young men and women, visited the Bureau of Entomology laboratory at Tallulah on July 24, spending most of the day in observing the practical field and laboratory operations and demonstrations in cotton dusting with ground machines and airplane.

O. E. Gahm, Bureau of Entomology, of the field laboratory at Arlington, Va., visited mushroom houses in Ohio and Minnesota during the greater part of July. He also spent some time at the University of Minnesota, where through the courtesy of that institution he was able to conduct some tests on the thermal death point of certain mushroom pests.

A total of 12 field assistants, Bureau of Entomology, have been appointed for the summer from various forest schools in different parts of the United States. These men are assisting on field projects in Montana, Idaho, California, Oregon, Nebraska, Minnesota, Massachusetts and North Carolina. Several of them have been with the Division of Forest Insects, one or two seasons previously.

Mr. George Edward Marshall, a graduate assistant in Entomology for the past year at the Kansas State Agricultural College, received his degree of Master of Science last July and was appointed Junior Entomologist in the United States Bureau of Entomology. He is located at Orlando, Florida, where he is working on the life history of the Mediterranean Fruit Fly.

Late in July Dr. B. A. Porter, Bureau of Entomology, visited the field laboratories at Vincennes, Ind., and Sandusky, Ohio, to make observations on work under way. In company with Messrs. R. F. Sazama and William P. Yetter, Jr., he spent half a day with W. P. Flint in southern Illinois, looking over experimental work on the control of the oriental peach moth.

Mr. A. B. Baird, Entomological Branch, reports considerable progress in the rearing, liberation and recovery of various species of parasites of the European corn

borer, the oriental peach moth, European earwig, and such forest pests as the larch sawfly, pine shoot moth, satin moth and lecanium scale. An endeavor is also being made to secure parasites of the woolly apple aphis.

Dr. F. C. Craighead, Bureau of Entomology, spent a few days in the middle of June at the forest-insect field laboratory at Ashville, N. C., consulting with J. A. Beal. Mr. Beal has been transferred to a new forest-insect field laboratory which is being established at Portland, Oreg., with F. P. Keen in charge. R. A. St. George will assume responsibility for activities at the Ashville laboratory.

The following appointments as field assistants were made early in the season. L. Jones, Twin Falls, Idaho; F. W. Fletcher, D. M. DeLong, D. F. Miller and R. W. Brubaker, Columbus, Ohio; E. C. Herber and H. Rosen, Philadelphia, Pa.; E. W. Jones, Walla Walla, Wash.: J. R. Thomson, Chadbourn, N. C.; V. E. Romney, State College, N. M.; V. F. Kent, Estancia, N. M.; J. F. Roe, T. E. Bronson, and J. H. Lilly, Madison, Wis.; and O. W. Rosewall, Baton Rouge, La.

W. E. Steenburg, of the Canadian Entomological Branch, and D. M. Daniels, of the New York (Geneva) Agricultural Experiment Station, spent two weeks in June at Moorestown, N. J., collecting larvae of the oriental peach moth and the strawberry leaf roller, both parasitized with *Macrocentrus ancylivora*, for shipment to the peach-growing sections of Ontario and New York that are infested with the oriental peach moth.

Visitors at the Gipsy-Moth Laboratory of Melrose Highlands during July included William H. Freeman, in charge of plant quarantine inspection, New York City, July 6; J. L. Webb and Harold S. Peters, of the Division of Insects Affecting Man and Animals, July 11, C. W. Stockwell, Plant Quarantine and Control Administration, Camden, N. J., July 12, and W. G. Bradley and C. A. Clark, of the European Corn Borer Laboratory, Arlington, Mass., July 22.

Dr. N. F. Howard, Bureau of Entomology, visited the bean insect laboratory at Estancia, New Mexico and conferred with J. R. Douglass, during the latter part of August. He also visited the Bureau laboratory at Alhambra, California, and in company with Mr. Campbell visited the bean growing section of southern California and the Experiment Station at Riverside, Cal. Returning via Berkeley, Cal. and Grand Junction, Colorado, Fort Collins, and Greeley, Colorado, he visited entomologists and plant pathologists at those locations.

On June 12, G. J. Haeussler, of the Bureau of Entomology field laboratory for the study of peach insects, at Moorestown, N. J., called at the National Museum to consult Bureau specialists about hymenopterous parasites of the oriental peach moth. He was on his way to the field laboratory at Hyeres, Var, France, maintained for the study of parasites of European insect pests introduced into the United States. He sailed on July 17.

The following were appointed temporary field assistants, Bureau of Entomology, and reported for duty in June: at Tallulah, La., J. C. Sherwin, K. H. Smith, J. D. Williamson, Syrus Conn, D. H. Ratcliff, S. D. Sumerford, L. W. Noble, Josh Randolph, H. D. Tate, V. L. Pearson, D. G. Long, L. B. Reed, A. B. Beavers, L. D. Christenson, B. C. Stephenson, and L. H. Subblefield; at Florence, S. C., W. A. Brunson, M. R. Buffkin, W. J. Moore, and E. V. Welsh; and at Tucson, Ariz., J. A. Downs.

Dr. M. D. Leonard, formerly of Cornell University has recently accepted the position of Chief of the Division of Entomology, Insular Experiment Station, Rio Piedros, Porto Rico and will take up his duties at Rio Piedros early in January next. At the present time Dr. Leonard is directing extensive experiments in the control of the codling moth in the Pacific Northwest for the Tobacco By-products and Chemical Corporation, with headquarters at Wenatchee, Washington.

Mr. H. G. Crawford, Entomological Branch, attended the ninth annual meeting of the International Great Plains Crop Pest Committee held at Treesbank, Man., August 8–10. Other officers of the Division present at the meetings were Messrs. Norman Criddle who is secretary of the organization, and his staff; Mr. H. L. Seamans, G. F. Manson and Miss Coutts, of the Lethbridge Laboratory and Messrs. K. M. King, E. McMillan and A. P. Arnason of the Saskatoon Laboratory.

C. R. Twinn, in charge of the Canadian Insect Pest Survey, which was organized in 1923 under the direction of the late R. C. Treherne, spent July 13 to 15 in Washington, studying the methods and equipment of the United States Insect Pest Survey. In addition to his work on the Survey, Mr. Twinn is in charge of investigations of stored-product insects and the work on mosquitoes carried on by the Dominion of Canada.

On June 8 Vladimir W. Alpatov, of the University of Moscow, Russia, now a student at Johns Hopkins University, visited the National Museum to examine the National Collection of Apis. Accompanying him was Th. Dolzhaasky of the University of Leningrad, Russia, now studying at the California Institute of Technology, at Pasadena, who was interested in seeing the collections of Coccinellidae, especially the North American material of the genus Coccinellidae, particularly in the Casey Collection.

Mr. P. D. Sanders, Associate Entomologist, University of Maryland, in company with Mr. A. D. Radebaugh, of the American Can Company of Baltimore, recently made a trip through the south. They visited Griffin, Georgia, for a demonstration of a new type of sprayer and from there went to Florida to examine the situation in regard to the Mediterranean fruit fly. On their return they went to Newport, Tennessee, to observe the Mexican bean beetle control operations at that point.

On May 28, Dr. B. A. Porter, Bureau of Entomology, attended a conference with entomologists of Virginia, Maryland and West Virginia, at Charles Town, W. Va., to observe an outbreak of the pistol case bearer, and to discuss methods of control. While this insect is normally of very minor importance, a few orchards in the Shenandoah Valley have developed serious infestations. One orchard in particular has suffered a defoliation averaging fully 50 per cent, in addition to considerable direct injury to the fruit.

Dr. Luang Siribaed Bisuddhi, of Siam, visited the Bureau of Entomology, Washington, July 11. Dr. Bisuddhi is perfecting his English under the direction of the Siamese Legation, and expects to enter Johns Hopkins University School of Hygiene and Public Health in September, where he will be a candidate for the degree of Doctor of Science in entomology. Before coming to the United States Dr. Bisuddhi was Director of the Public Health Laboratory of the Department of Health of Siam. He will make observations in the field of entomology while in this country.

L. W. Brannon, Norfolk, Va., N. F. Howard, Columbus, Ohio, and W. H. White, Washington, D. C., all of the Bureau of Entomology, accompanied by entomologists

from Maryland and New Jersey, and others interested in the control of the bean beetle, inspected bean fields on the Eastern shore of Maryland, June 27 and 28. This inspection trip was conducted by Prof. E. N. Cory, State Entomologist of Maryland and had for its principal object the gathering of information on the results obtained by the commercial growers on the control of the bean beetle under conditions prevailing in this large commercial area.

In June, B. R. Coad, Bureau of Entomology, visited the State Experiment Station at College Station, Tex., and conferred with Dr. F. L. Thomas relative to plans for investigation of the pink bollworm and cotton bollworm. An arrangement has now been perfected by which the bollworm investigations in Texas will be handled on a cooperative basis similar to that for the work on the pink bollworm. Under this system the investigations will be carried on jointly by means of funds provided by the State of Texas and the Bureau of Entomology, with Dr. Thomas in direct supervision of the field work.

Dr. J. M. Swaine, Entomological Branch, spent the latter part of June at Westree, Ont., supervising and directing airplane dusting experiments in the control of the spruce budworm. This work was carried out with the cooperation of the Dominion Air Service, which supplied a tri-motor Ford plane, and the Ontario Forestry Service, which supplied the necessary poisoned dust, the camp and supplies. The experiments covered an area of approximately two square miles of infested forest and resulted in the acquisition of much valuable data regarding airplane dusting in general. The percentage of larvae killed was not entirely satisfactory owing to local conditions and the habits of the species which render it resistant to this method of control.

The Bureau of Entomology is beginning this season an intensive study of the parasites of the codling moth. At the outset the work will consist chiefly of a survey of the principal apple regions of the United States, to bring up to date and amplify our information regarding the identity, distribution and relative abundance of the various parasites affecting the codling moth. Some 20 entomologists in various parts of the country, including many of the field men of this division, have agreed to cooperate and send in for rearing material collected in their respective sections. Luther Brown has been assigned to the project, which is centered at the field laboratory at Silver Spring, Md.

In a press release from Berkeley, Calif., dated July 13, entitled "Bean Weevil was pest as far back as history goes," there is the following interesting statement: "Red Lima Beans taken from the ancient Indian graves in the Valley of Ica and Ancon Necropolis in Peru show the work of the bean weevil. Ica records date from 1 to 500 A.D., whereas those of Ancon are more recent by a thousand years. However, according to Professor Essig, both antedate the arrival of the Spanish in Peru. An adult bean weevil taken from the Ancon beans does not differ in anatomical characteristics from the bean weevils of today. The insect was first described by Thomas Say in 1831, from specimens taken in Louisiana."

Perez Simmons, Bureau of Entomology, reports that in the month of July, 15 visits to ranches and 8 to packing houses were made from his laboratory, and that there were 29 visitors to his office, including H. R. Fulton, Citrus and Subtropical Fruit Disease Investigations, Bureau of Plant Industry, E. R. DeOng, consulting entomologist, San Francisco, Dr. H. N. Hansen, of the Department of Plant Pathology, University of California, W. B. Parker, of the California Spray Chemical Co.,

who formerly worked on dried-fruit insects for the Bureau of Entomology, Dooley P. Wheeler, Horticultural Commissioner, and J. L. Quail, Farm Adviser, Merced County, Calif., W. S. Follette, Assistant Secretary and C. D. Fisher, Chemist, Dried Fruit Association of California, Samuel R. Coker, of the Pedigreed Seed Company, Hartsville, S. D. and Dr. R. T. Cotton.

During the month of July the collections of Coleoptera in the National Museum were extensively rearranged, and the work of identification and research on the classification of Coleoptera was divided up among the several specialists more definitely than before. Under the present arrangement H. S. Barber will specialize on the Chrysomelidae and the cantheroid, mordelloid, and several other smaller series of coleopterous families; L. L. Buchanan will handle the Rhynchophora, the Adephaga, and a few other families; Dr. E. A. Chapin has taken over the scarabaeoid, tenebrionoid, and most of the staphylinoid series and several individual families from other series; W. S. Fisher will continue his specilization on the Buprestidae and Cerambycidae, and will also be responsible for identifications of beetles belonging to the cucujoid, bostrichoid and elateroid series of families.

On the termination of the dusting experiments at Westree, the tri-motor Ford plane was sent to Manacouagan where areas of hemlock infested by the hemlock looper were dusted under Dr. Swaine's direction. This work was carried out in cooperation with two pulpwood companies who own the affected limits, and the Quebec Provinicial Government. With the experience acquired at Westree the required quantities of poisoned dust were applied very satisfactorily and the results secured were excellent. The infestation of the hemlock looper at the mouth of the Manacouagan river so far as can be judged has now been brought under control. The success of these experiments leads to the belief that a valuable control method has been developed which may be utilized with great benefit for the protection of pulpwood forests.

A shipment of nearly nine thousand puparia of *Paratheresia signifera* Tns., collected by H. A. Jaynes at Cartavio, Peru, was received at the Bureau of Entomology field laboratory at New Orleans on July 11. Mr. Jaynes expects to send from ten to fifteen thousand more puparia from the same place. He has been collecting this and other species of parasites of the sugarcane moth borer in Argentina, but owing to the approach of cold weather in that country he moved temporarily to Peru. The parasites are sent to New York in the cold-storage rooms of steamships, are received by Harold C. Hallock, of the Japanese Beetle Laboratory, and are immediately transferred to special refrigerator boxes and sent to New Orleans by express. Wm. H. Freeman, of the Plant Quarantine and Control Administration, also cooperates in transmitting the boxes of parasites.

W. R. Walton, Bureau of Entomology, left Washington during May for a tour of inspection of the southern and southwestern field laboratories of the division. He visited New Orleans, Houma, and Crowley, La., and Beaumont and San Antonia, Tex. At Albuquerque, N. M., he was joined by V. L. Wildermuth and J. C. Frankenfeld, of the field laboratory at Tempe, Ariz. The party visited the range caterpillar territory in northeastern New Mexico, where the eggs of the insect were found to be present in extreme numbers. After completing plans for the summer work there, an inspection was made of the summer cattle ranges at the higher elevations. Messrs. Wildermuth and Walton also visited several parts of New Mexico and Arizona, to examine and discuss the infestation by the southwestern corn borer. Among the

regions examined was the area lying between Phoenix and Tucson, Ariz., and extending to the Mexican border. E. G. Davis, of the field laboratory at Tempe, assisted in this survey. Mr. Walton returned to Washington June 12.

J. E. Dudley, Jr., Bureau of Entomology, in charge of the field laboratory at Madison, Wis., reports that in the vicinity of Columbus, Wis., the heavy, beating rains early in July reduced the infestation of the pea aphid to a lower point than has ever before been reached since the work on this insect was started in 1922. After this low point was reached and reproduction had nearly ceased, as the pea crop approached maturity a large number of several species of natural enemies began to take their toll until, at the time of writing, July 30, there was less than one aphid per sweep of the net. Conditions in that locality were just the opposite of those in northeastern Wisconsin, where rains have been neither frequent nor heavy, and a heavy infestation with considerable loss to the pea crop has been experienced. It is believed at present that the heavy rains were the principal factor in the great difference between the infestations in the two localities.

Four large shipments of parasites of the Japanese beetle were received at Moorestown in June from T. R. Gardner, of the field laboratory at Yokohama, Japan. Two of these shipments consisted of beetle larvae parasitized by the dexiids, *Prosena siberita* and *Dexia ventralis*. Few people appreciate the work and expense entailed in preparing this material for shipment; for example, in the case of *Prosena*, the female flies have first to be caught, and are then dissected under a binocular microscope and the minute larvae within the larval sac are placed, two or three in number, on the grubs of the host Popillia. These minute larvae almost immediately enter their host. The grubs are stored in "grub plots" out of doors for the winter, and shipment is made the following spring. Much painstaking labor is thus required, all of which is expensive in time and money. Such a shipment as that received here this spring, consisting of some 20,000 parasitized grubs packed in a minimum of sterile soil, weighs 3,000 pounds, and the express charge from Seattle to Moorestown alone was $300.11. The other two shipments of parasites consisted of adults of *Tiphia vernalis*. The wasps, which are natives of Korea, are shipped in tins provided with all the necessities of life. The shipments this year arrived in remarkably fine condition. The first, of 5,285 wasps came through with 86.5 per cent alive and in good condition. The second shipment, which consisted of older adults (some 5,700 in number), arrived with 64.7 per cent alive.

Horticultural Inspection Notes

Mr. John M. Corliss has been assisting in narcissus inspection work in Michigan during part of August and September.

Mr. S. D. Whitlock, who for the past three years had been engaged in plant quarantine work in Porto Rico, was transferred to New York on July 24, 1929.

Mr. John H. Painter, formerly employed by the Plant Quarantine and Control Administration, was reinstated and reported for duty at New York on July 16, 1929.

Mr. Jack D. Smith, a graduate of Texas A. & M. College, was appointed Junior Plant Quarantine Inspector and assigned to the Port of Brownsville, Texas, effective July 10, 1929.

Mr. A. G. Harley, of the Philadelphia inspection force, was transferred to Porto Rico on September 1, to fill the vacancy caused by Mr. Whitlock's return to the mainland.

Mr. Otto L. Cook, a graduate of Mississippi A. & M. College, was appointed Junior Plant Quarantine Inspector and assigned to the port of Nogales, Arizona, on August 1, 1929.

Mr. L. M. Scott left Washington on September 9 for the purpose of making field inspections of special permit material being grown at several points in New England and New York State.

Mr. E. P. Reagan, a graduate of the Texas A. & M. College, was appointed Junior Plant Quarantine Inspector on August 26, 1929, and is assisting Mr. Frost at the Thayer International Bridge.

Mr. Lee A. Strong, Assistant Commissioner of Agriculture of California spent several months this summer in a mountain camp in that State recuperating from a serious illness in the spring.

Mr. Jose A. Ramos, a graduate of the College of Agriculture, Mayaguez, Porto Rico, was appointed Junior Plant Quarantine Inspector on August 16, 1929, and assigned to the Port of El Paso, Texas.

Mr. Luther A. Frost, who has been stationed at Hidalgo, Texas, since November, 1927, assumed charge of the plant quarantine work at the new International Bridge at Thayer, near Mercedes, Texas.

Mr. W. J. Douglass who has been engaged in plant quarantine work at Douglas, Arizona, for the past year assumed charge of the plant quarantine activities at the port of Naco, Arizona, on September 1.

Mr. Wm. R. Shinn, who has been stationed at Seattle, Washington, for the past two years was transferred to Bellingham, Washington, on September 1 to assume charge of the plant quarantine activities at that port.

Mr. A. F. Burgess, Melrose Highlands, Mass., is scheduled to present a radio talk over WRC and the National Broadcasting Company chain of stations on September 23. The talk will be entitled: "Progress in the Gipsy Moth Campaign."

Mr. R. R. Roberts, a graduate of Texas A. & M. College, who received an appointment as Junior Plant Quarantine Inspector at Douglas, Arizona, on August 31, 1929, was transferred to Brownsville, Texas, on September 7, 1929.

Mr. Frank N. Wallace, State Entomologist of Indiana, spent several days in Washington, D. C., the second week of September, conferring with department officials regarding European corn borer activities which are being conducted cooperatively in Indiana.

Mr. G. W. R. Davidson of the Plant Quarantine and Control Administration, in cooperation with scouts of the Bureau of Plant Industry, is inspecting the premises and vicinity of peach-growing nurseries in Georgia in connection with the enforcement of the phony peach disease quarantine.

The New York State Department of Agriculture and Markets has recently issued Circular No. 397, which constitutes the 1929 edition of the annual publication entitled "The Inspection, Certification, and Transportation of Nursery Stock in the United States, New York State, other States, and Canada."

Dr. H. Garman, who had forty years of distinguished service with the University of Kentucky, retired on July 1st from active duties as Head of the Department of Entomology and Botany. He still retains a connection with the University, however, and will continue to study and write along entomological lines.

Mr. J. A. Munro, State Entomologist of North Dakota, reports that non-resident nurseries are no longer required to file a bond and pay a fee in order to sell nursery stock in that State. A copy of the inspection certificate of the State in which the nursery is located is, however, required to be filed with the State Entomologist.

Mr. J. I. Griner, Supervisor of Horticulture of the Department of Agriculture of the State of Washington, recently resigned to go into commercial work. Mr. George E. Harter has been appointed to take his place. Mr. Harter for several years was district horticultural inspector in the same department, with headquarters located at Wenatchee.

At the Extraordinary session of the Twelfth Legislature of Oklahoma, a State Plant Board was created but nursery inspection activities still remain with the separate department known as the State Board of Agriculture. Mr. R. E. Montgomery continues as State Nursery Inspector and Mr. W. J. Lackey as State Plant Quarantine Officer.

Mr. E. R. Sasscer, in charge of Foreign Plant Quarantines, left Washington on July 23 for the Pacific Coast, for the purpose of investigating plant quarantine problems at the various ports of entry in the States of Washington, Oregon and California. On his return, Mr. Sasscer stopped at several of the Mexican Border ports and New Orleans, returning to Washington on September 2.

Raspberry mosaic is being given special attention by the nursery inspectors of North Dakota this season. Out of nineteen nurseries inspected, the only instance in which certification was refused was a case in which this disease was present on the premises. Shipments of raspberry nursery stock entering North Dakota are required to be accompanied by a certificate showing that the stock is mosaic-free.

Mr. K. C. Sullivan, who for several years has been on the entomological staff of the Agricultural Experiment Station at Columbia, Mo., has recently been appointed Plant Commissioner of the newly organized State Plant Board of Agriculture. His headquarters will be at Jefferson City. The Plant Commissioner will hereafter be responsible for the nursery inspection and plant quarantine activities formerly directed by the Entomologist of the Agricultural Experiment Station.

The Mediterranean fruit fly quarantine regulations were revised, effective September 1, 1929, to modify many of the conditions under which host fruits and vegetables and other restricted articles might be moved from Florida to other parts of the United States, and specifying conditions under which host fruits and vegetables which had originated in Florida might be shipped from and between non-infested States. An important provision of the new regulations relates to the sterilization of host fruits and vegetables.

The Acting Secretary of Agriculture, on July 29, 1929, issued a notice under which it was ordered that all species and varieties of chestnuts and acorns may hereafter be imported from foreign countries only under permit and on compliance with the safeguards prescribed in Regulation 2 supplemental to Federal Quarantine No. 56. On the same date the Plant Quarantine and Control Administration issued Circular PQCA-241 prescribing the conditions under which chestnuts and acorns from foreign countries would be admitted during the shipping season 1929–30.

Mr. George B. Sleesman of Ada, Ohio, has recently been appointed as a nursery inspector under the Bureau of Plant Industry of the Pennsylvania Department of Agriculture, for the Philadelphia district, to fill the vacancy caused by the resignation of Mr. F. F. Smith. Mr. Sleesman is a graduate of Ohio Northern and recently completed work for his M.S. degree at Ohio State University. He will assist with the nursery inspection work in the Philadelphia district and have immediate supervision of the investigational work on nursery insects conducted at the bureau laboratory, Willow Grove, Pa.

The Bureau of Plant Industry of the New York State Department of Agriculture and Markets, in cooperation with Dr. R. D. Glasgow, State Entomologist of New York, and the Long Island Bulb Growers Association, is conducting a series of experiments on Long Island relative to the control of bulb flies, bulb rots and eelworms. This work is in addition to and distinct from the regular narcissus inspection work on Long Island which is being carried out under the direction of Mr. R. L. Clement, Hempstead, L. I., with the temporary assistance of Mr. C. E. Baker of the Plant Quarantine and Control Administration.

Dr. Wilmon Newell, Plant Commissioner of Florida and Agent of the United States Department of Agriculture, in charge of Mediterranean fruit fly eradication in that State, spent part of the first two weeks of September at Washington consulting with the Plant Quarantine and Control Administration with respect to various features of the fruit fly eradication work. Mr. A. F. Camp, in charge of the cleanup section of the Mediterranean fruit fly eradication staff in Florida, visited Washington early in August and again in September for consultation with members of the Plant Quarantine and Control Administration regarding the progress of the fruit fly work in Florida. Dr. J. H. Montgomery and Dr. H. H. Hume, spent about a week in Washington early in August in connection with the new revision of the Mediterranean fruit fly quarantine regulations.

Apicultural Notes

A combination apiary house and insectary has recently been built in connection with the experiment station apiary of the North Dakota Agricultural College.

Mary L. White, who has been employed at the laboratory for several summers, has been reappointed temporary Field Assistant, Bureau of Entomology, to assist in the work on bee diseases. Willis R. Doyle also has been appointed temporary Field Assistant.

Dr. H. E. Barnard, President of the American Honey Institute, has been selected by Mr. Hoover to develop the Child Health and Protection Work. This will take Dr. Barnard to all sections of the country to organize special research work along nutrition lines.

The Texas Beekeepers Association by the provisions of its constitution has always been an educational organization. Because of this fact, its meetings are open to everything that is of interest to beekeepers. As an outcome of the discussions held at its sessions the various marketing organizations in Texas in the past have come as a result of the resolutions passed by the Texas Beekeepers Association.

The Queen Breeders and Package Shippers' Association of Texas held their meeting at College Station, August 1st. A discussion of the affairs of the association was participated in by W. O. Victor, J. D. Yancey, Roy Weaver, T. P. Robinson and H. E. Coffey. The report of the secretary showed that the organization was in fine

shape and was active in securing the objects desired by the Queen Breeders. The officers are now W. O. Victor, president and H. E. Coffey, Whitsett, secretary.

The Press Service announced on May 31 that arrangements had been made to include chemical tests of honey where official United States certificates of grade are desired. At the present time these tests will be made by the food-products inspection service of the Bureau of Agricultural Economics. This arrangement does not apply to samples which are graded, without charge, merely for color, but to lots which are to have certificates of inspection. The press release should be consulted for further details.

H. E. Coffey, Whitsett, Texas, has issued a call to all beekeepers of the State of Texas and those who market their honey within the State to meet Sept. 1st and 2nd at the Plaza Hotel, San Antonio. The object being to form a body that will work in co-operation with similar selling associations in the Southeast States and with the Federal Farm Board. Representatives from the Extension Service and Experiment Station, of A. & M. College and of the Federated Farm Board will be present.

The extension service of A. & M. College, Texas, conducted a short course at the Medina-Hereford Ranch of W. T. Montgomery, eighteen miles southwest of San Antonio, July 17th and 19th. On the 18th the staff of the State Apicultural Research Laboratory set up their portable extracting house on the Short Course Grounds and conducted an all day demonstration in the manipulation of hives. Live bees were used and the demonstrations were carried on within the screened house for the protection of the audience. The explanations were given by H. B. Parks, Chief of the Division of Apiculture and the manipulations were carried on by A. H. Alex, Queen Breeder of the Laboratory. A very large crowd saw the work done and many including some beekeepers saw for the first time queen bees on combs becoming acquainted with the worker bees shortly after introduction.

The Texas Beekeepers' Association held its annual meeting at College Station, July 29th to August 1st. This is the 52nd annual meeting of the Association and the average attendance was 100. The first session was given over to reports of delegates. T. W. Burleson of Waxhachie reported on the meeting of the American Honey Producers' League at Sioux City, Iowa. The afternoon session was composed of reports on scientific investigation. Prof. Horlacher of A. & M. College reported upon the effect of violet-rays on queen bees. H. B. Parks of the Apicultural Laboratory and S. E. McGregor, Chief Inspector, reported on honey flows. J. A. Moore of the Dallas State Fair reported on his observations of selling opportunities for farm products at the State Fair. That night Dr. and Mrs. Bilsing entertained the beekeepers at their home. This social affair is known as the Beekeepers' Buzz. The unique feature of this year's entertainment was the identification of honey plants. Mr. W. O. Victor of Uvalde was able to name 36 out of the 37 plants presented. The first session of the second day was given over to a discussion of co-operative marketing. This was led by Mr. J. V. Ormand, State Apiarist of Arkansas. Dr. Paulson of the Texas Agricultural Experiment Station and Mr. H. E. Coffey, secretary of the Nueces Valley Beekeepers' Association. As a result of this discussion a resolution was passed calling a meeting of all those interested to form such an association. Dr. F. L. Thomas, State Entomologist, gave a brief report on the present status of the Inspection Service. The officers for the coming year are: H. A. Victor, Taylor, president; H. B. Parks, secretary, Rt. 1, Box 368, San Antonio; Dr. Warren Whitcomb, Jr., of Southern States Bee Culture Field Station, University Station, Baton Rouge, La., was an interested attendant upon these meetings.

Notes on Medical Entomology

Dr. W. V. King, Bureau of Entomology, returned to the field laboratory at Mound, La., June 15, after a furlough of six months, during which he conducted studies of the Anopheles mosquitoes in the Philippines under the auspices of the International Health Division of the Rockefeller Foundation.

J. L. Webb and H. S. Peters, Bureau of Entomology, returned to Washington on July 17, having completed the season's investigation of cattle grubs in Vermont. With a view of securing specimens of ectoparasites of birds, or information concerning such ectoparasites, they made contacts with several men before leaving New England.

The Florida State Board of Health has applied to the Bureau of Entomology to have T. E. McNeel continue his studies on the biology and control of mosquitoes which he has been carrying on at Zellwood, Fla., since last March. Mr. McNeel will continue this work for at least several weeks longer.

H. M. Brundrett, Professor of Horticulture and Entomology at John Tarleton College, Stephenville, Tex., has been given a temporary appointment to continue investigations of fly sprays and spraying apparatus, to which he has given some attention during the past two summers. Mr. Brundrett is making his headquarters at the field laboratory at Dallas, Tex.

On June 11 F. C. Bishopp and H. S. Peters, Bureau of Entomology started on a trip for reconnaissance of the cattle grub, extending from Washington through Pennsylvania, southern New York, western Connecticut, western Massachusetts, Vermont, and New Hampshire. Some experiments with these insects were performed in western Vermont. Mr. Bishopp returned to Washington June 29. J. L. Webb joined Mr. Peters at Burlington, Vt., June 30, to continue the work under way there.

Mr. David G. Hall, a graduate assistant in Entomology for the past year at the Kansas State Agricultural College, received his degree of Master of Science last June and was appointed Assistant Entomologist in the Division of Insects Affecting the Health of Man and Domestic Animals, United States Bureau of Entomology. Mr. Hall is located at Coachella, California, where he is working on the eye gnat a, species of Hippelates which is a serious pessed of man in the Coachella Valley, California.

A move has been inaugurated by the Office of Public Buildings and Public Parks, Washington, D. C. for the elimination of mosquitoes in public grounds and around public buildings, especially the White House. On July 16, F. C. Bishopp, Bureau of Entomology, attended a meeting called to discuss plans of procedure. The others attending the meeting were Col. U. S. Grant, 3rd, Director of Public Buildings and Public Parks, Dr. W. C. Fowler, District Public Health Officer, Dr. J. T. Boone, of the Navy Medical Corps, Maj. Robert D. Harden, of the Army Medical Corps, Dr. C. E. Waller, of the United States Public Health Service, Maj. S. M. Corbett, Medical Inspector of Public Buildings and Public Parks, and Ralph E. Tarbett, of the U. S. Public Health Service.